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Manhattan's Real Property Values and the Migrant Puerto Ricans

By ROSALIND TOUGH* *and* GORDON D. MAC DONALD**

THE BELIEF that minority groups devaluate real property when they move into established neighborhoods has been termed a "myth."[1] However, from the point of view of the general public, this idea has often been accepted as a fact. How deeply it has been rooted in the public mind has been demonstrated time and time again; owners of property in a neighborhood in settlement by a group with minority status have become panicky and, in their haste to leave the neighborhood, have sold their properties at a sacrifice. From time to time, such experiences have appeared to make the devaluation thesis a reality rather than a myth.

Once again an invasion of new migrants is pushing out the original residents of an area; Manhattan is losing its residents of the middle economic groups and their places are being taken by Puerto Ricans from the island. Since many of the latter are in the low socio-economic groups, it is little wonder that the effects of the new migration have become the subject of speculation. Within the last few years residential deterioration and slum conditions have become much more wide spread in Manhattan and throughout the city. It has been pointed out that the Puerto Ricans did not create the sub-standard neighborhoods in which they are now living and that slums have existed in Manhattan and later in the other boroughs of New York City for decades before the arrival of the most recent migrants. Nevertheless, many of the older residents of New York City firmly believe that these people, coming in large numbers, are responsible for rapidly deteriorating neighborhoods. It is pertinent to know, therefore, what is happening both to the living conditions and to the property values in the areas into which the Puerto Ricans are moving.

The Migrant Puerto Ricans

During the period 1950-1956 the net migration from Puerto Rico to New York City was more than 250,000 persons (Table I). In 1950, 85 percent of the newcomers settled in New York City. By 1956 a change in this trend was evi-

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[1] Joseph Monserrat, "Some Data on the Population Trends of New York City, Must Information for its Citizens," *Journal of Educational Sociology*, November 1952, p. 111.

denced, i.e., the estimated percentage had decreased to 65. Thus an increasing proportion of the migrants are going to other sections of the United States.

TABLE I—PUERTO RICAN MIGRATION TO NEW YORK CITY: 1941-1956*

Year	Net Out-Migration from Puerto Rico	Estimated Net Migration to New York City	
		Annual[1]	New York City[2] (as percent of total)
1956	52,315	33,900	65
1955	45,464	31,600	70
1954	21,531	16,100	75
1953	69,124	51,800	75
1952	59,103	45,500	77
1951	52,899	42,300	80
1950	34,703	29,500	85
1949	25,698	23,100	90
1948	32,775	29,500	90
1947	24,551	23,300	95
1946	39,911	37,900	95
1945	13,573	12,900	95
1944	11,201	10,600	95
1943	3,204	3,000	95
1942	1,679	1,600	95
1941	643	600	95

* *Source: Bulletin, Puerto Rican Migration to New York City,* Department of City Planning, the City of New York, February 1957.

[1] Estimates are rounded to nearest hundred.

[2] Rate to New York City estimated by Migration Division, Commonwealth of Puerto Rico.

In contrast to the earlier waves of immigrants to New York City, who settled primarily in the lower East Side of Manhattan, Puerto Ricans have spread throughout Manhattan (Table II). In 1956 they constituted about one-eighth of the total population of the borough. For that matter, they have not limited themselves solely to Manhattan but can also be found throughout the four other boroughs of New York City, with greatest concentration in the Bronx and Brooklyn and much less concentration in Queens and Richmond. Despite these population movements from Puerto Rico many Americans know relatively little about the island and its people. A belief

TABLE II—PUERTO RICAN POPULATION OF NEW YORK CITY BY BOROUGHS: 1954*

	Total Population	Puerto Rican Population	Percent of Total Population
New York City[1]	8,050,000	487,500	6.1
Manhattan	1,910,000	240,000	12.6
Bronx	1,500,000	130,000	8.7
Brooklyn	2,710,000	105,000	3.9
Queens	1,720,000	10,000	0.6
Richmond	210,000	2,500	1.2

* *Source: A Summary in Facts and Figures,* Commonwealth of Puerto Rico, Migration Division, Department of Labor, April 1957, p. 17.

[1] As of December 31, 1956, the *estimated* total population of New York City was 8,075,000; the Puerto Rican population was 577,000, or 7.1 percent of the total.

that most Puerto Ricans are non-white is an error. According to the United States Census of 1950, 92 percent of the migrants and 80 percent of the Puerto Ricans living on the island were classified as white.[2] Because of the difference in racial origins within this group population statistics are often given as white, Negro and Puerto Rican.

Neither is it true that the migrants are largely agricultural workers. Only 5 percent of the migrants were employed in agriculture before coming to continental United States and about half of them were in manufacturing and processing while living on the island.[3] Only 26 percent of the migrants are unskilled; an additional 35 percent are semi-skilled and the remainder are skilled or white collar workers.[4] But newcomers to the mainland find themselves at the bottom of the economic ladder and a large number have to take unskilled jobs.

The Puerto Ricans, of course, are not immigrants. By virtue of the Jones Act which became law on March 2, 1917,

[2] *A Summary in Facts and Figures,* Commonwealth of Puerto Rico, Migration Division, Department of Labor, April 1957, p. 19. (Data based on *1950 Census of Population*).

[3] *Ibid.,* p. 19.

[4] *Ibid.,* p. 19.

they are American citizens.[5] As such, the Puerto Ricans can enter the mainland of the United States without any of the complications to which the immigrant is subject. To no small extent this is one of the reasons for the recent rapid increase in the number of Puerto Ricans migrating from the island to the mainland (Table I).

Another factor contributing to migration is that space on the island of Puerto Rico is at a premium. Approximately 35 miles wide and 100 miles in length (3435 square miles) the island has a population today of more than 2,250,000: by 1960 this number is expected to be approximately 2,880,000.[6] This estimate takes into consideration a net migration of about 35,000 persons per year to the United States.

A relatively small area and a relatively high concentration of people creates high population density within the island of Puerto Rico. Actually a density of 663 persons per square mile on the island is approximately twelve times the population density in the United States, 56 per square mile.[7]

It is to be expected that large numbers of people annually will seek to improve their status on the mainland; it should be noted, however, that migration is a two-way process and that in addition to the stream of migrants from the island, numbers of Puerto Ricans leave the United States annually to return to their homeland.

Housing Conditions and Levels of Living in Puerto Rico

But rapid changes are taking place in Puerto Rico. The slums, primarily clumps of one-room hovels, fabricated from slats or corrugated iron, are being replaced by government subsidized housing, some of it federally financed. The "operation bootstrap" program, through new diversified industrial production, has brought peak employment and wages to Puerto Rico. Of the 517 plants started since 1947, more than three-fourths are operating today, the majority in the black.[8] The results of the Commonwealth's economic development program are changing the character of living on the island. Between 1940 and 1956 there was an increase of 40.4 percent in persons employed in industry rather than agriculture.[9] With this change has come an increase in family purchasing power; in 1956 the average family income in Puerto Rico reached a peak of $2,400 (compared with $660 in 1940). This represents a real increase in family purchasing power, even after allowing for an 80.2 percent rise in the cost of living.[10]

Perhaps the best data to indicate the improvement of living conditions in Puerto Rico are those on life expectancy at birth. In 1910 the average life expectancy was 38 years; in 1940 the average Puerto Rican was expected to live 46 years; by 1955 a figure of 68 years compares favorably with a 70-year life expectancy for Continental United States.[11]

Rapid improvement in public health measures on the island have markedly reduced death rates, including the infant

[5] "Puerto Rico is now self-governing under a constitution drafted by a constitutional convention, approved by the island voters in a referendum, ratified by the U. S. Congress and approved by the President of the United States. The entry into force of the constitution on July 25, 1952 was the culmination of 52 years of steadily increasing local autonomy. Major advances were made in 1917 when Puerto Ricans were declared to be United States citizens and the legislature became wholly elected by popular vote." *General Information About Puerto Rico*, Migration Division, Department of Labor, Commonwealth of Puerto Rico, no date.

[6] *Bulletin, Population Changes in New York City*, Department of City Planning, the City of New York, November 22, 1954, p. 2.

[7] *Bulletin, Puerto Rican Migration to New York City*, Department of City Planning, the City of New York, February 1957, p. 3.

[8] "Industry and Markets," *New York Herald Tribune*, April 29, 1957, Sect. 2, p. 3.

[9] *A Summary in Facts and Figures, op. cit.*, p. 13.

[10] *Ibid.*, p. 5.

[11] *Ibid.*, p. 5.

mortality rate.[12] The death rate of 7.3 per 1,000 population (1956) rate in Puerto Rico is lower than that for Continental United States, which is 9.4 per 1,000 population. The Puerto Rican birth rate, however, is much higher, although in recent years it has been decreasing. In 1956 it was 34.1 per 1,000 population, about ten points higher than in the United States.[13] Thus a combination of a declining death rate and a relatively high birth rate results in an increase which creates surplus population, some of which has been migrating to the United States.

Property Valuations in New York

Any attempt to analyze changing property values in New York City involves two sets of variables. One of these is the market value of real estate, i.e., the day-to-day prices at which pieces of real property are sold. The other variable is the assessed values of these properties, or the values which the New York City Department of Taxes and Assessments has placed on the pieces of real property which are changing from one owner to another. For the purpose of this study, the relationships between assessed values and market values have been used as the primary measuring rod for relative changes in property values over a period of time. According to the real property tax law of New York State,[14] applicable to New York City, the assessed value of real estate should be 100 percent of market valuation. Actually, however, this seldom occurs. In periods of depression market values are considerably below assessed values; in periods of prosperity the opposite is generally the case. It can be assumed, therefore, that in specific areas of New York City, when market values do not follow these trends, the deviations are of significance.

Manhattan Sales. Beginning with 1951, for Manhattan as a whole, real properties have generally been selling above their assessed values. In 1956 market values were 22.5 percent above assessed values (Table III). This percentage was considerably higher than in the years immediately preceding and is an indication of a rapid rise in real estate values.

TABLE III—PROPERTY SOLD, MARKET VALUATIONS RELATED TO TOTAL ASSESSMENTS: 1940-1956*

Year	Total Transactions	Market Values Related to Assessed Values	
		Below %	Above %
1956[1]	2,852	....	22.5
1955	3,375	....	18.6
1954	2,886	....	9.0
1953	2,869	....	8.3
1952	3,171	....	7.1
1951	3,239	....	4.2
1950	3,439	.7	....
1949	2,891	6.4	....
1948	3,673	2.4	....
1947	4,179	....	.9
1946	7,793	3.2	....
1945	5,852	20.3	....
1944	4,967	30.3	....
1943	3,473	34.3	....
1942	2,340	36.2	....
1941	2,704	34.2	....
1940	2,549	27.4	....

* *Source: Manhattan Real Estate, Open Market Sales*, Research department, Real Estate Board of New York, Inc., Volumes 1940-1956.

[1] For 1956 the number of residential sales, 2,276, was 79.8 percent of total sales; the value of residences sold was 56.1 percent of the total market value of all sales.

[12] *Ibid.*, p. 5.

[13] "The [New York] State Law provides that real property shall be assessed at its full value. Under the [New York] City Charter, the assessors must annually assess real property at the sum for which in their judgment, each separately assessed parcel of real estate, under ordinary circumstances would sell if wholly unimproved, and separately stated, the sum for which under ordinary circumstances, the same parcel would sell with the improvements, if any, thereon." *Knowing the Tax Department and the Tax Commission of the City of New York*, Municipal Building, New York City, 1947, p. 11.

[14] For the purpose of this study, *standard housing* includes those residential structures which meet the requirements established in such legislation as the New York State Multiple Dwelling Law, 1929 (as amended), the New York City Multiple Dwelling Code, 1955, and various other New York City municipal ordinances which are applicable to housing structures. Responsibility for the enforcement of these regulations rests with such New York City agencies as the Department of Buildings, Department of Health, Department of Fire, Department of Sanitation, Department of Welfare, etc.

In contrast to the foregoing, in the eleven-year period from 1940 through 1950, properties in Manhattan generally sold below their assessed values. For six of the eleven years, 1940 through 1945, the sales took place at prices from one-fifth to more than one-third below assessed values (Table III).

Market prices below assessed valuations, the general trend until as recently as 1951, can be interpreted as follows. Despite the real property tax law of New York State, which provides for assessed values to be the equivalent of market values, assessed values are much less volatile than market values. Since at least 45 percent of the total revenues of New York City are dependent on the returns from the real property tax, from the point of view of the city it is generally not desirable to lower assessed valuations. Thus despite the remonstrances of the property owners during the Depression, the period of World War Two and the immediate post-war years, assessed values in Manhattan continued to be higher than market values.

Residential properties in Manhattan have followed the general trend for properties as a whole, i.e., recently they have been selling above their assessed values. In 1956 market values were about one fourth (24.0 percent) above assessed values; in the years immediately preceding, although the differential was not as great, nevertheless the same trend was evident (Table IV).

A number of misapprehensions exist concerning the types of properties that are sold in Manhattan. One of these is the belief that these properties are primarily sky-scrapers, used for business and commercial purposes. In the daily newspapers of the metropolis, it is the sale of the Empire State building, for example, that makes news. Actually the majority of the properties sold each year are residential rather than business structures; in 1956, 79.8 percent of all the properties sold were residential.

In harmony with the above misapprehension, it is generally thought that properties changing hands are high priced. This is not the case. In 1956, for example, about one third of the residential structures sold were at prices below $25,000. An additional one-half of the residential properties exchanged hands at prices from $25,000 to less than $100,000. Although 1956 was a year of peak real estate prices, of the 2,276 residential buildings changing hands, only 20 were sold at market prices of $800,000 or more.

TABLE IV—MANHATTAN BOROUGH: RESIDENTIAL PROPERTIES SOLD: MARKET VALUES RELATED TO TOTAL ASSESSMENTS, 1952-1956*

Range of Market Values (in dollars)	Number of Sales by Years					Total Market Values *Above or Below* Total Assessed Values (in percent)				
	1956	1955	1954	1953	1952	1956	1955	1954	1953	1952
Total	2,276	2,749	2,360	2,333	2,627	24.0	20.8	7.2	5.8	4.7
Under 12,500	214	247	251	296	427	−20.9	−19.4	−23.6	−19.9	−11.2
12,500-24,999	578	680	691	720	816	.3	−.1	−3.1	−1.7	−4.0
25,000-49,999	641	831	686	655	703	13.8	10.9	6.0	4.3	2.1
50,000-99,999	463	529	435	390	383	30.0	20.7	9.9	8.3	9.5
100,000-199,999	206	270	159	137	141	31.2	26.3	12.2	11.0	4.9
200,000-399,999	108	105	87	69	72	35.8	22.1	14.2	7.3	8.9
400,000-799,999	45	56	33	46	48	21.8	17.8	2.7	3.8	3.3
800,000 and over	20	31	18	40	37	26.9	39.8	8.0	7.3	6.9

* *Source: Manhattan Real Estate Open Market Sales,* Research Department, Real Estate Board of New York, Inc. Volumes 1952-1956.

One other misapprehension concerning residential property being sold in Manhattan is that the borough deals primarily in elevator multi-family structures. Such is not the case. For example, in 1956, of the 2,276 residential buildings changing hands, 1,777 buildings were walk-ups; comparable situations existed in the years for which such data are available, i.e., 1952, 1953, 1954 and 1955.

The Local Communities. What happens to property values in the local communities within Manhattan is not necessarily the same as that for the borough as a whole. Selected factors influence property values in specific areas of the borough.

For the purpose of this study, three sections of Manhattan are chosen for analysis: *Spanish Harlem*, an area in which there is a concentration of Puerto Ricans and which was largely *sub-standard* in terms of housing facilities before the arrival of these new migrants; *North and West of Central Park*, an area in which the Puerto Ricans are in process of concentrating, and which was largely *standard* in terms of housing facilities before the arrival of the new migrants; and *Yorkville*, the Control Area, an area with relatively few Puerto Ricans, and which has both standard and sub-standard housing but recently is definitely on the *up grade* in terms of new housing construction, largely for families of high incomes.

Spanish Harlem. The most colorful of the three areas mentioned above is East Harlem or Spanish Harlem, so called because of the concentration of Spanish-speaking peoples within its boundaries. This large area, extending roughly from East 96th Street up through Harlem to East 163rd Street, from Central Park to the East River, has a Caribbean atmosphere. A multiplicity of factors contribute to making Spanish Harlem unique. Here dark-skinned people evidence a preference for bright colors; here in the spring and summer are gay push-carts with a choice of flowers available at modest prices; here from an ice-cream vender can be purchased a delicacy topped with highly colored flavoring; here in the shops, often with open sidewalk displays, can be obtained exotic fruits and vegetables; here in adjacent shops is clothing of the brightest hues and here in the local theater a Spanish-speaking movie is being shown.

The gaiety and color of Spanish Harlem exists despite the sub-standard housing conditions under which many of the families live. Much of this area was a slum before the Puerto Ricans arrived.[15] The recent great influx of these people has added to the overcrowding; conditions which were sub-standard at the time of the 1950 Census, when the Puerto Ricans were relatively few, have in recent years become progressively worse.

The part of Spanish Harlem chosen for detailed analysis extends from East 100th to East 106th Streets and from Fifth to Third Avenues; it was assumed that the real properties analyzed between Fifth and Park Avenues might be somewhat different than those between Park and Third Avenues. Thus data were compiled for the two sections—West of Park Avenue and East of Park Avenue.

West of Park Avenue. To the person not familiar with Manhattan's many

[15] "Carver Houses will accommodate families of low income, not necessarily, however, many of the families living on the site prior to its rehabilitation. The bases for selection of families is determined by the administrative policies of the New York City Housing Authority: these policies are applicable to the city as a whole. For families who do not qualify for government subsidized low-rental housing (the incomes of many site tenants are too large or too small for them to qualify) the New York City Housing Authority has a relocation program. It has relocated over 33,000 site tenants; today (1954) about 16,000 tenants remain on the sites of various approved housing projects." *Tenant Relocation Report*, New York City Planning Commission, January 20, 1954, p. 2.

neighborhoods, an address on Fifth, Madison, or Park Avenues seems to carry social status. Such, however, is not necessarily the case. Beginning at the section of upper Manhattan at East 96th Street, where the New York Central Railroad comes above ground, the character of the housing along these avenues and along the adjacent side streets rapidly deteriorates. Empirical data support the conclusions from general observation in the area west of Park Avenue (between Park Avenue and Central Park, from East 100th to 106th Streets). For each year, from 1940 through 1956, total sales prices of properties have been below total assessed valuations (Table V). In recent years, this trend of market values

TABLE V—AREA WEST OF PARK AVENUE: MARKET VALUATIONS RELATED TO TOTAL ASSESSMENTS FOR RESIDENTIAL PROPERTIES SOLD: 1940-1956*

Years[1]	Number of Sales	Total Assessed Values	Total Market Values *Above* or *Below* Total Assessed Values	
			Amount	Percent
1956.....	....	.....	.....	.....
1955.....	1	23,000	−125	−.5
1954.....	2	138,000	−16,500	−11.9
1953.....	....	.....	.....	.....
1952.....	2	35,500	−13,781	−36.8
1951.....	7	819,000	−154,928	−18.8
1950.....	22	728,500	−62,700	−8.6
1947.....	18	319,500	−124,663	−36.9
1946.....	17	450,500	−192,110	−42.7
1945.....	29	702,500	−335,062	−47.7
1941.....	5	169,000	−21,350	−48.4

* *Source: Manhattan Real Estate, Open Market Sales*, Research Department, Real Estate Board of New York Inc., Volumes 1941, 1945-1947 and 1950-1956. The area west of Park Avenue includes Fifth, Madison and Park Avenues; East 100-East 106th Streets (Blocks 1606-1611) Manhattan borough, New York City

[1] From 1951 through 1956, only 12 residential properties were sold at an average price of $69,180 per sale; no residential properties were sold in 1956. Much of this area is now being utilized for a government-subsidized, low-rental housing project. The year 1941 represents a typical pre-World-War-2 year; 1945, 1946 and 1947 were immediate post-World-War-2 years in which building regulations of the National Production Authority were still in effect.

is contrary to that existing for Manhattan as a whole. As has been indicated, since 1951 in Manhattan market values of real properties has generally exceeded assessed valuations (Table IV).

However, in the area west of Park Avenue, few properties have changed hands recently, due largely to the construction of Carver Houses, a subsidized low-rental housing project erected by the New York City Housing Authority.[16] Recognition of the sub-standard character of the housing in the blocks extending from East 99th to East 106th Streets and from Madison to Park Avenues is evidenced in terms of the city's rehabilitation of this area. In the area west of Park Avenue only twelve residential properties changed hands in the five-year period, 1951-1955 inclusive. (No properties were sold in 1956). The average price of the twelve residential properties was $69,180. Most of these were converted brownstone houses, generally built in the latter part of the nineteenth century to accommodate families of the middle and upper income brackets. A few were old-law tenements, built at approximately the same period, i.e. before the New York State Tenement House Law of 1901. Today, both these types of properties are overcrowded, generally housing two or more Puerto Ricans or other families, in accommodations originally built for one family.

East of Park Avenue. The area east of Park Avenue (including Park, Lexington and Third Avenues and extending from

[16] "Conversions include all types of structural alterations which increase or decrease the number of dwelling units . . . . In many instances conversions that increase the number of occupants of the buildings, intensify the slum making process." *Ibid*, p. 16. "A vicious circle exists. The demand for cheap housing of any type continues to increase with the continued arrival of Negroes from the South, of Puerto Ricans and of immigrants from Europe. That minority of landlords, ready to profit from extreme human need, and in many cases tenants themselves, hurriedly convert their tenements, brownstones and apartment houses to 'furnished apartments' to rent to these new arrivals. These conversions increase, and the need for additional tenants causes the unprincipled landlord to urge his present tenants to encourage others to come here." *The Present Housing Emergency in New York City*, Committee on Housing, Welfare and Health Council of New York City, April 1953, p. 9.

East 100th to East 106th Streets) has a concentration of old law tenements, many of which now have stores on the first floors and housing accommodations throughout the rest of the building. This use of the premises is particularly apparent along the avenues.

The assumption that property values east of Park Avenue would be somewhat different than those west of Park Avenue is substantiated by the empirical data. From 1951 through 1956 inclusive, 120 properties changed hands at an average price per property of $17,630. This low figure is indicative of the sub-standard character of these properties (Table VI).

TABLE VI—AREA EAST OF PARK AVENUE: MARKET VALUATIONS RELATED TO TOTAL ASSESSMENTS FOR RESIDENTIAL PROPERTIES SOLD, 1941-1956*

Year[1]	Number of Sales	Total Assessed Values	Total Market Values *Above* or *Below* Total Assessed Values	
			Amount	Percent
1956.....	15	301,500	24,580	8.2
1955.....	12	352,500	53,300	15.1
1954.....	24	228,200	−909	−.04
1953.....	8	125,000	20,400	16.3
1952.....	27	384,400	12,776	3.3
1951.....	28	583,400	30,440	5.2
1950.....	24	334,500	−93,060	−27.8
1947.....	26	459,500	−57,744	−12.7
1946.....	20	334,000	−19,471	−5.8
1945.....	37	697,200	−374,460	−53.7
1941.....	12	260,500	−103,614	−39.8

* *Source: Manhattan Real Estate, Open Market Sales*, Research Department, Real Estate Board of New York Inc., Volumes 1941, 1945-1947 and 1950-1956. The area east of Park Avenue includes Park, Lexington and Third Avenues; East 100-East 106th Streets (Blocks No. 1628-1633), Manhattan borough, New York City.

[1] From 1951 through 1956, 120 residential properties were sold at an average price of $17,630 per sale.

Furthermore, this average price is considerably lower than the average price ($69,180) of the relatively few properties which changed hands during the same period in the area west of Park Avenue.

During the last six years, 1951-56, real properties in the area east of Third Avenue, have been selling above their assessed values. Undoubtedly, the rapid influx of Puerto Ricans into this area has stimulated a demand for these properties. Over the same period real properties in the area west of Third Avenue have been selling below their assessed values. The fact that the governmental housing project, Carver Houses, was being built in the area had an influence both on assessed values and market values. Actually, assessed values were relatively much higher in the area west than in the area east of Third Avenue, which may partially explain why the market values have been lagging behind the assessments.

North and West of Central Park. The section of Manhattan north and west of Central Park is undergoing rapid transition. Stretching roughly from West 90th Street to West 150th Street and from Central Park to the Hudson River, it includes two sections, Riverside Drive and Central Park West, in which were the homes of the wealthy. Riverside Drive, once one of the most exclusive streets of New York City or, for that matter, of the world's metropoli, is now generally considered to be on the down grade. Central Park West, with its high priced elevator apartments and apartment hotels overlooking Central Park, is still recognized as a good address in Manhattan. But beginning with the streets numbered in the nineties, just behind the expensive facade, the slums are located along the side streets.

Much of the housing construction located north and west of Central Park is either what were originally single-family dwellings, the former homes of the well-to-do, or what were previously high-rental elevator apartment buildings. There, apartment buildings with plate glass mirrors and crystal chandeliers in the entrance foyers attest to the economic status of the former tenants. For some years, families of middle and pri-

marily of low socio-economic status have been moving into the area. Since the section north and west of Central Park is adjacent to Harlem, some of these families have been Negro; many of the recent arrivals have been Puerto Rican.

With the coming of the Puerto Ricans in large numbers the character of the neighborhoods located in the area north and west of Central Park has been changing rapidly. Owners of real property have been taking advantage of the shortage of housing available to the newcomers; "illegal conversions" have resulted in overcrowding. "Illegal conversions" has been the term applied in New York City to structural changes which do not comply with the standards for multi-family dwellings established both by New York State and New York City. [17] One common illustration of an illegal conversion is the subdividing of rooms. To attain some privacy for tenants housed in little space it has become common practice to partition a room into two or more cubicles, such partitions reaching only partially to the ceiling. The results enable accommodations which originally were planned for one family to house two or more families of relatively low incomes. Generally speaking, these families are the newest arrivals to Manhattan or other boroughs of New York City.

For the above accommodations Puerto Rican families, and occasionally other families, can be found paying as much as $15.00 and $20.00 per furnished room per week. Accommodations available are generally furnished rooms, rather than unfurnished; in New York City many landlords who have renovated their buildings and who rent the resulting accommodations furnished manage to evade existing rent regulations. In some instances the landlord is not directly involved in sub-letting rooms to individual families. Instead a Puerto Rican family itself signs a lease for a large apartment, five or six rooms or more, in a high rental elevator building. The family income may be low but funds are obtained by sub-letting rooms to relatives and friends, generally on the basis of one or two rooms per family. Whenever two or more families are housed in accommodations originally planned for one family, joint use of kitchens and bathrooms results. This is just one other aspect of overcrowding which, when coupled with lack of maintenance of these facilities, rapidly results in sub-standard conditions.

As a result of the changes in use of some housing properties in the area north and west of Central Park, contrasts in levels of living are great. Today, immediately adjacent to the overcrowded buildings accommodating the recently arrived Puerto Rican families can be found buildings accommodating tenants largely in the upper socio-economic brackets. In most instances the latter are the types of tenants for whom the buildings were originally constructed; how long tenants in the upper socio-economic brackets will continue to remain in the area, so rapidly undergoing transition, is difficult, if not impossible, to predict. For the purposes of this study, a small section of the area north and west of Central Park was selected for detailed study. This section extends from West 106th to West 114th Streets and from Riverside Drive to Columbus Avenue, including sections of Amsterdam and Manhattan avenues.

The uncertainties involved with regard to the future of an area in transition undoubtedly are reflecting themselves in the property values in this area. Market

[17] *Bulletin*, Department of City Planning, New York City, March 1, 1955 (See Table I, "Population New York City and Boroughs by Race and Ethnic Group, 1950-1954.)

values have been consistently below assessed values, with the exception of the two years 1953 and 1955 (Table VII). Since this trend is contrary to that for Manhattan as a whole for the period 1951 through 1956, it is highly significant. What is equally significant is the average price of the properties sold in the six-year period 1951-1956 inclusive. During this period many of the 158 residential properties changing hands were large multi-family elevator buildings; the average price of these structures was $132,487.

TABLE VII—AREA NORTH AND WEST OF CENTRAL PARK: MARKET VALUATIONS RELATED TO TOTAL ASSESSMENTS FOR RESIDENTIAL PROPERTIES SOLD, 1941-1956*

Years[1]	No. of Sales	Total Assessed Values	Total Market Values *Above* or *Below* Total Assessed Values	
			Amount	Percent
1956.....	22	2,294,000	−155,747	−6.8
1955.....	22	1,537,500	145,600	9.5
1954.....	21	1,618,000	−67,255	−4.1
1953.....	19	5,679,000	157,324	2.8
1952.....	41	5,497,347	−55,799	−10.0
1951.....	33	4,577,000	−294,020	−6.4
1950.....	37	4,327,500	−470,562	−10.9
1947.....	37	4,531,000	−647,856	−14.3
1946.....	55	7,076,781	−446,389	−6.3
1945.....	66	6,849,000	−801,849	−11.7
1941.....	15	2,509,500	−417,287	−16.6

**Source: Manhattan Real Estate, Open Market Sales*, Research Department, Real Estate Board of New York Inc., Volumes 1941, 1945-1947 and 1950-1956. The area north and west of Central Park includes Columbus, Manhattan and Amsterdam Avenues plus Riverside Drive; West 106th-West 114th Streets (Blocks No. 1842-1845; 1861-1866; 1878-1881; 1882-1885; 1892-1895) Manhattan borough, New York City.

[1] From 1951 through 1956, 158 residential properties were sold at an average price of $132,487 per sale.

From the above, it is quite apparent that the buildings involved are not what were previously generally thought of in New York City as slum properties. However, that today overcrowding and lack of maintenance has often produced slum conditions is equally true. That these properties often sell below their assessed valuations is a reflection of these conditions. Annual net yields from overcrowded properties inadequately maintained are high. When such properties are sold, owners who have recouped their initial investments over relatively short periods of time can afford to sell structures (which have become increasingly sub-standard) below their assessed values.

Yorkville: The Control Area. For comparative purpose, Yorkville, located along New York City's East River has been included in this study. This area, having on its southern boundary Sutton Place and below this the United Nations Building, in the neighborhood of 42nd Street, and extending up to Carl Schurz Park and beyond to East 96th Street, is being rebuilt primarily with housing for families of high socio-economic status. The new construction is entirely multi-family in character; here and there, however, there still exists some of the older single-family homes of the well-to-do which still accommodate only one family. (Among these, in the vicinity of Carl Schurz Park, can be found the mansion of the Mayor of New York City.)

A number of factors have undoubtedly contributed to the fact that the Yorkville section of Manhattan is benefiting from a series of property improvements. The United Nations Building, located along the banks of the East River from 42nd to 48th Streets, has had a wide-spread influence; prior to its construction, this area accommodated a number of slaughter houses which had an adverse influence on adjacent property values. The East River Drive, completed within the past decade, did much to improve the waterfront in the Yorkville area, This highway, constructed by the City of New York, provides not only automobile lanes of travel but also small parks and playgrounds for the use of local residents.

Perhaps the most important factor explaining the character of Yorkville, east of Third Avenue, is the fact that many of

the residents in the older housing structures (old-law tenements and brownstone single-family dwellings, converted to multi-family living) are Austrians, Germans and Czechoslovakians. It is generally recognized that these Europeans maintain the properties in which they live, even when they are tenants rather than owners. Neighborhoods inhabited by these people are apt to be more attractive than those, equally old, inhabited by some other ethnic groups.

The more than two decades of living in the Yorkville area by these Germanic peoples has given it an old-world atmosphere. In the local restaurants and shops can be found choice Viennese pastries and excellent beer; in the local clubs and movies both German and English are spoken, often interchangeably; in the local lodge hall folk dancing can be seen.

Needless to say, housing in the Yorkville area has not been generally available to the migrant Puerto Rican. The new high priced elevator apartments have been beyond his reach. The older buildings have housed the Germanic families, most of whom are rooted to the area and have shown little desire to move. Even in this area, however, a Puerto Rican family has occasionally found shelter; but this is relatively rare. Hence it seemed desirable to use Yorkville property values for comparative purposes.

For the purposes of this analysis, the section of Yorkville selected for detailed analysis lies between Third and First Avenues and extends from East 70th to East 79th Streets. This is a section wherein there are many old-law tenements and brownstone houses occupied largely, at the moment, by the Germanic peoples as mentioned above. In recent years, without exception, residential properties in Yorkville have been changing hands at prices well above their assessed valuations. The peak in prices occurred in 1956 when the market values of the 46 properties sold were more than 77 percent above the assessed values (Table VIII). Furthermore, this trend of market values above assessed values has extended over a ten-year period in Yorkville. As far back as 1946 market prices exceeded assessed valuations.

TABLE VIII—YORKVILLE: MARKET VALUATIONS RELATED TO TOTAL ASSESSMENTS FOR RESIDENTIAL PROPERTIES SOLD, 1941-1956*

Years[1]	No. of Sales	Total Assessed Values	Total Market Values *Above* or *Below* Total Assessed Values	
			Amount	Percent
1956.....	46	1,840,000	1,427,330	77.6
1955.....	54	3,067,650	889,494	28.9
1954.....	49	2,436,500	746,253	30.6
1953.....	38	2,044,000	386,438	18.9
1952.....	28	1,773,500	294,917	16.6
1951.....	30	1,288,000	242,233	18.8
1950.....	14	842,000	218,357	25.9
1947.....	34	2,639,500	554,325	21.0
1946.....	51	3,225,100	203,344	6.3
1945.....	45	2,849,500	−393,839	−13.8
1941.....	13	436,000	−167,541	−38.4

* *Source: Manhattan Real Estate, Open Market Sales,* Research Department, Real Estate Board of New York Inc., Volumes 1941, 1945-1947 and 1950-1956. Yorkville includes First, Second and Third Avenues; East 70th-East 79th Streets (Blocks No. 1425-1541) Manhattan borough, New York City.

[1] From 1951 through 1956, 245 residential properties were sold at an average price of $67,087 per sale.

No such marked optimism is evidenced in the prices of properties sold either in Spanish Harlem or in the area north and west of Central park. In these areas, as was hereinbefore indicated, market values in recent years have either been below assessed values or have fluctuated from year to year. However, the trend in Yorkville of market values above assessed values for residential properties is in harmony with the trend of values pertaining for Manhattan as a whole, with significant differences. The first of these is that the boom in property values started earlier in Yorkville (1946) than in Manhattan as a whole. Furthermore,

when property values in Yorkville are compared with those in Spanish Harlem, located just north of the Yorkville area, great differences are noted. Old-law tenements which are selling in the area east of Park Avenue (Spanish Harlem) for approximately $17,000 per structure bring prices about twice that amount when located in Yorkville. A comparable depressed situation is evident when prices for these old structures located north and west of Central Park are compared with the relatively high prices at which they sell in the Yorkville area.

Housing Conditions and Levels of Living for the Migrants in Manhattan

The influx of the Puerto Ricans coupled with an increase in the nonwhite population (11 percent between April 1, 1950 and December 31, 1954, reaching a total in 1954 of 840,000) has been concomitant with a movement of white middle-income families out of New York City to the suburbs.[18] It has been estimated that by 1970 New York City will have lost three-quarters of a million white persons,[19] largely of this middle-income group.

Although the Puerto Ricans are scattered throughout New York City, there are certain areas in which they tend to concentrate.[20] Within the borough of Manhattan, two areas with rapidly growing Puerto Rican population have been included in this study, i e., East Harlem, or what is popularly known as Spanish Harlem and the area north and west of Central Park. In contrast, although Yorkville, located along the East River just south of Spanish Harlem has relatively few Puerto Ricans (largely because low-rental housing accommodations have not been available in that area) it has been included for comparative purposes.

To ascertain prevailing housing conditions and levels of living of the migrants, a field study was undertaken during the period 1953-55. Within each of the three sections of Manhattan mentioned above, a few blocks were chosen for intensive analysis. For Spanish Harlem, the blocks selected extended from East 100th to East 106th streets and from Fifth to Third Avenues; for the area west of Central Park, the blocks selected extended from West 106th to West 114th Streets and from Riverside Drive to Columbus Avenue; for Yorkville the blocks selected extended from East 70th to East 79th Streets and from Third to First Avenues.

A total of 500 Puerto Rican families were interviewed by Hunter College students during the period 1953-55; for comparative purposes 250 non-Puerto Rican families living in the same neighborhoods also were visited. Because of the greater concentration of the Puerto Ricans in both Spanish Harlem and the area north and west of Central Park, the majority of the interviews came from these two areas, 200 Puerto Rican families and 100 non-Puerto Rican families in each area; Spanish Harlem and north and west of Central Park. It was with some difficulty that the student interviewers found 100 Puerto Rican families living within the blocks selected for study in the Yorkville area; 50 non-Puerto Rican families were interviewed there.

In terms of scientific method, certain limitations should be pointed out in reference to the Hunter College study. The 500 Puerto Rican families inter-

[18] *Bulletin, op. cit.*, Nov. 22, p. 2.

[19] *Ibid.*, p. 2.

[20] In a 1948 publication the Welfare and Health Council of New York City listed five neighborhoods in New York City as predominately Puerto Rican. Today, almost a decade later, these areas of New York City have high concentrations of Puerto Rican people. The neighborhoods listed were as follows: (1) East Harlem (Manhattan); (2) the upper West Side district (Manhattan); (3) the Riverside District (Manhattan); (4) the South Bronx; and the Red Hook-Gowanus and the Greenpoint-Williamsburg districts of Brooklyn. *Puerto Ricans in New York City*, Welfare Council of New York City, February 1948, p. 16.

viewed in relationship to approximately the 100,000 families of Puerto Ricans living in Manhattan is a sample of about one-half of one percent. Furthermore, although a number of the student interviewers could speak Spanish, some could not. But quite often some member of the Puerto Rican family could speak English and acted as interpreter. For a number of the students participating in the study this was their first experience in interviewing. Despite the above limitations, the writers believe that the findings of the study are indicative of the housing conditions and the levels of living for the migrant Puerto Ricans living inManhattan. The fact that the authors of this study are familiar with housing and neighborhood conditions prevailing in the various sections of Manhattan formed the basis for this conclusion. In addition, objective data obtainable from both governmental and social agencies in New York City substantiate the findings of the Hunter College study.

Upon analyzing the responses to the questionnaires, it was found that, irrespective of the location of the families within Manhattan, the answer to the questions involving housing conditions and levels of living were very similar. In other words, for the Puerto Rican families the variations which existed were in no way influenced by the specific location of the families within Manhattan. For this reason the data on housing conditions and levels of living obtained from the three areas are presented as one whole. The following section is a summary of the findings.

Condition of Buildings. Both the Puerto Rican and the non-Puerto Rican families interviewed, approximately one-half of whom were Negro, were living in structures built in the latter part of the nineteenth or early twentieth centuries. Some of these were old-fashioned brownstone houses, originally designed for single family occupancy; some were old law tenements[21] and some were apartments, subdivided to accommodate two or more families. These apartments were located in elevator buildings which had originally housed families of middle or high socio-economic levels.

Housing structures which have numbers of violations of New York City's various codes were generally considered to be sub-standard. Illustrations of these violations include the following: windows lack panes of glass; main entrances to apartment buildings are without locks and sometimes even without doors; kitchens and bathrooms, originally constructed to meet the needs of one family, are being used for two or more families; plumbing facilities in kitchens and bathrooms do not function and are not repaired; fire escapes have obstructions; sprinkler systems for fire protection are faulty; and lack of sufficient receptacles (which are emptied periodically) results in accumulation of garbage and rubbish throughout the building and in the adjacent streets and vacant lots. The structures in which the Puerto Rican families are living are poorly maintained. This is equally true for the non-Puerto Rican families, many of whom are Negro, who are living in the slum neighborhoods.

Comments from student interviewers indicate the conditions as those prevailing in the old-law tenements. "All the build-

[21] The New York State Tenement House Law of 1901 (supplanted, for New York City, by the New York State Multiple Dwelling Law of 1929 as amended and the New York City Multiple Dwelling Code of 1955) established housing standards in New York City. The Tenement House Law, although not adequate in terms of current thinking, established regulations much in advance of anything which had preceded. Structures built prior to the enactment of the 1901 law are referred to as "old-law tenements." Old law tenements were generally built on the standard lot in Manhattan, 25-foot frontage and 100-foot depth. Constructed five or six stories high, the tenements had about four apartments to each floor. Toilet facilities were in the hall, each toilet facility serving two or more families.

ings were old and dilapidated; halls were narrow and dimly lighted; they were dirty and needed painting." Tenants who voiced complaints often mentioned the length of time it took to have repairs made and the fact that landlords often entirely overlooked such requests.[22]

Housing Facilities. With the coming of large numbers of Puerto Ricans to New York City and the resulting overcrowding, what constituted adequate housing facilities a few years ago, today has become entirely inadequate. Facilities which were inadequate in 1950 have become progressively more so.

Crowding of two or more families into accommodations originally planned for one family has resulted in joint use of plumbing facilities. More than half of the 500 Puerto Rican families interviewed lacked private bath and toilet accommodations; in contrast the 250 non-Puerto Rican families generally had these facilities.

The majority of the families queried, both Puerto Rican and non-Puerto Rican, did have central heat. A number of these families, however, supplemented inadequate central heating with kerosene stoves and a few families heated their apartments entirely with these stoves. Periodic fires from such kerosene stoves have been reported in New York City; provision has been made to bar their use in the New York City Multiple Dwelling Code of 1955.

Crowding. More than two-thirds of the 500 Puerto Rican families interviewed were living under crowded conditions, i.e., more than one person per room.[23] Two persons per room was a common condition; in a few instances five and even six persons were found to be living in one room.[24] The size of the Puerto Rican household ranged from two to thirteen persons. These larger households generally contained more than one family, although the people living together were often related to each other. In Puerto Rico the pattern of the larger family prevails, which explains, partially at least, the overcrowding among these families. The head of the family assumes responsibility not only for his wife and children but in addition often for relatives, sometimes quite distantly related.[25]

Rentals. Within the same areas the recently arrived Puerto Ricans were paying relatively higher rentals than white and Negro families. Rentals paid by the

[22] "This then is the situation in the region [East Harlem] where the greatest number of Puerto Rican newcomers are trying to find homes. Landlords do not make repairs; the repairs needed in these buildings are extremely costly and unsatisfactory to make. Tenants are afraid to report violations, even minor ones, because upon official inspection, the whole house may be condemned. If a building is condemned the Housing Authority must rehouse the tenants, and this the Authority cannot do because there are no vacancies. There is nowhere for the dispossessed to go. The result is continuous deterioration of houses and lowering of living conditions." *Puerto Ricans in New York City, op. cit.*, p. 18. "The virtual non-existence of a building maintenance policy or program in thousands of old tenement houses in New York City is due a lot, in my opinion, to the employment of janitors who know absolutely nothing about the Multiple Dwelling Law plus their total lack of building maintenance know-how." Statement by Joseph Platzker, former Commissioner of Housing and Buildings of the City of New York. Committee on Housing, *The Present Housing Emergency in New York City*, Welfare and Health Council of New York City, April 1953, p. 14.

[23] The United States Census defines crowding in terms of occupied dwelling units having 1.51 persons or more per room. Between 1940 and 1950 the Census reported only a slight increase in crowding, from 4.5 percent to 4.6 percent. It has been suggested that the increase reported was small because the worst overcrowding (because of its obvious illegality) was concealed from the census enumerators. Committee on Housing, *op. cit.*, p. 4. As early as 1948, for 109 apartments surveyed in East Harlem, the Welfare Council reported 1-1/5 persons per room or 5⅓ persons per apartment. *Puerto Ricans in New York City, op. cit.*, p. 19.

[24] "On a room basis, greater overcrowding among these groups (non-white and Puerto Rican) is evident. Only 4 percent of the white dwelling units contained more than 1.5 persons per room. However among non-whites and Puerto Ricans there was twice as much 'room crowding'; 10 per cent of the non-white and Puerto Rican dwelling units had more than 1.5 persons per room." *Tenant Relocation Report*, New York City Planning Commission, January 20, 1954, p. 25.

[25] "The island family often includes aunts, uncles, cousins, grandparents, nieces and nephews and sponsors at Baptism. When a child is deprived of the care of parents by abandonment, death or illness, a relative usually takes over." C. Wright Mills, Clarence Senior, and Rose Kohn Goldsen, *The Puerto Rican Journey* (New York: Harper Brothers: 1950), p. 8.

Puerto Rican families ranged from $25.00 to $84.00 per month; the number of rooms per family ranged from one to six, although the majority of the families were living in either two or three room units.[26]

More than one-third of the Puerto Rican families paid more than 20 percent of the family income for rent. For low income families 20 percent of family income to be paid for rent, including utilities, is a generally accepted standard. A few families, primarily those in which there was more than one wage earner, paid less than 10 percent of the family income for rent.

Occupations. The majority of the Puerto Rican males and all the females in the families interviewed were doing unskilled work.[27] About one half of the families had two or more members contributing to the family income.[28] The average weekly wage of the employed males was approximately $53.00; the average weekly wage reported for females was approximately $39.00.[29] Low wages could be related to three causal factors: the length of stay in the United States, lack of knowledge of the English language and limited formal education.[30]

Recreation and Other Factors. The recreational patterns of the Puerto Rican families in Manhattan were found to be somewhat comparable to the non-Puerto Rican families living in the same neighborhoods; a difference in languages, however, resulted in some distinctions. Almost all the Puerto Rican families interviewed attended the movies (English and sometimes Spanish). Almost all the families were found to have at least one radio; probably because of the greater cost generally involved television sets were less prevalent than radios among Puerto Rican families.[31]

It is often assumed that the Puerto Ricans do most of their buying in the Puerto Rican stores, particularly since many of these are springing up in the neighborhoods into which the migrant families are moving. However, among the families interviewed this did not prove to be the case. These families seem to have adopted the American pattern of patronizing the chain store, at least for the staple food products. The specialties not obtainable in the chain store are purchased in the local Spanish food store.

Adjustment to Neighborhood Conditions. The neighborhoods into which the Puerto Rican migrants are moving are not pri-

[26] The Bureau of Labor Statistics has designed a budget for a family of four, including an employed father, a housewife, and two children under fifteen. "The budget represents the estimated dollar cost required to maintain this family at a level of adequate living to satisfy prevailing standards of what is necessary for health, the nurture of children and for participation in community activities. The monthly rental expenditure is about $60.00 or $720.00 per annum for a five-room apartment, utilities, heat and hot water, meeting American Public Health Association minimum standards. For October, 1951, $4,083 was needed to maintain a minimum standard of living at existing price levels. The proportion of the budget allocated to rent was 17.7 percent." *Tenant Relocation Report, op. cit.*, p. 20.

[27] "Most of the Puerto Ricans are employed in manufacturing and service industries, though some hold white-collar and professional positions, especially in New York City. There are perhaps 20,000 in New York's garment industry and about 16,000 in hotels and restaurants." *Business Week*, May 2, 1953, p. 152.

[28] "Most of the migrants now on the continent seem anxious to stay. About 95 percent of the men and more than half of the women—many in domestic service—are gainfully employed. Of the 5 percent on relief in New York City, more than three-fourths are women with dependent children." *Ibid.*, p. 152.

[29] In its 1948 study the Welfare Council of New York City reported: "The majority of the 112 families reporting on their incomes, 70 percent, are completely self-supporting, either from wages or from unemployment insurance, and other non-relief income. Their weekly incomes range from $12.50 to $122.00 with an average income of $43.75." *Puerto Ricans in New York City, op. cit.*, p. 20.

[30] For the male migrants to Continental United States, the median years of school completed (persons 25 years old and over) is 8.0; for the female migrants, the median is 7.5. *A Summary of Facts and Figures, op. cit.*, p. 19.

[31] In commenting on the recreational activities of the 117 families interviewed in a specific block in East Harlem, the Welfare Council report (1948) states: "The residents of the block appear to be as limited in their use of the few recreational facilities available to them as in their use of educational opportunities .... Many of the children use Central Park and over a third use the school playground, a quarter of them went to camps. No other recreational facility except the movies draws more than two or three. Fifty-one of the families attend the movies, only six of the mothers make use of the neighboring settlement house and only one family uses the public library." *Puerto Ricans in New York City, op. cit.*, p. 20.

marily residential. For the most part, along with the sub-standard housing accommodations can be found the small grocery, candy and vegetable stores, the cleaning and tailor shops, the store front churches, the pawn shops and the pool halls. For the most part, also, these neighborhoods are made up of cement pavements and structures of brick and stone; open space with trees and grass generally do not exist. Despite the characteristics of these neighborhoods the newcomers are adjusting themselves to their environments. Here the new arrival comes to join friends or relatives who have arrived at an earlier date; here he can converse with other Puerto Ricans in his native Spanish; here he can find the foods to which he is accustomed.

Largely because of the above factors, almost two-fifths of the 500 Puerto Rican families interviewed stated that they liked the neighborhoods in which they lived.[32] Simultaneously, however, about half of the families indicated that crowded conditions were one of the major problems of living in the neighborhood; they added further that lack of money made it impossible for them to do much, if anything, to improve their living conditions.

That the Puerto Rican family would be willing to move into a new environment with standard housing conditions, if he could afford to do so, was also evidenced. In answer to the question—should the opportunity exist either to move into a housing project or to the suburbs, would you be willing to move—about half of the families responded in the affirmative. Those who answered in the negative or failed to answer the question were generally uncertain as to just what such changes would involve.

[32] "Nevertheless, except for a few, these people wish to move to better and larger apartments. The few wish to stay in this neighborhood because by letting rooms, they can cover their rent and supplement their incomes or because they prefer to stay in a Spanish-speaking neighborhood." *Ibid.*, p. 19.

Influences on Property Values

From the above study two trends become apparent: (1) In the Yorkville area where few Puerto Rican families live market values for residential properties are following the general trend for Manhattan as a whole, i.e., during the past six years they have been selling above assessed valuations. However, in Yorkville the upward movement has been more rapid and relatively greater than that for Manhattan. (2) In the three neighborhoods studied where the migrant Puerto Rican families are concentrating, residential properties either continue to sell below assessed values (west of Park Avenue) or both above and below assessed values in specific years beginning with 1951 (east of Park Avenue and north and west of Central Park). However, it is doubtful that these trends can be attributed primarily to the influence of the Puerto Ricans per se. They constitute only one of a number of variables which are involved.

In the determination of real property values a multiplicity of factors must be considered. Among these may be mentioned age of buildings, initial type of construction, character of maintenance throughout the years, and degree of obsolescence. In addition, government regulations in the form of taxation, rent controls, zoning, building codes, health ordinances, and the like also play a part. The extent to which such regulations are enforced plays a significant role in the net returns from specific buildings.

Although each of the above factors has entered into the determination of market values for residential properties in Manhattan as a whole, selected factors have been unusually significant in the neighborhoods into which the Puerto Ricans are moving. In other words, properties accommodating Puerto Rican families tend to yield relatively high net returns,

largely because such factors as overcrowding and lack of maintenance have enabled owners to get the maximum from each dollar of investment. In many instances so profitable are these properties that within a few years owners recoup their initial investments in addition to what would be considered a normal rate of return on their investments.

Properties which are overcrowded and not adequately maintained rapidly become sub-standard. Such is the case for many of the buildings accommodating the Puerto Rican families. When such properties do change hands the relatively low market price is indicative of the fact that many improvements are needed. To the seller who has already recouped his initial investment whatever price the building brings represents a profit. Thus in numbers of instances such buildings are sold below their assessed valuations and even below the market prices of previous years.

Despite the recent attempts of the New York City Department of Buildings, in cooperation with other municipal agencies involved, to "crack down" on landlords who do not comply with state housing legislation and municipal ordinances, violations continue. Even today, when penalities imposed by the New York City Magistrates' courts are heavier than formerly, the overcrowding and the nonconformance to housing standards are widespread. Speculators, motivated by the attainment of high annual net profits, can afford to assume the risks involved and to pay, if necessary, a periodic fine.

In answer to the question—do minority groups devaluate real property when they move into established neighborhoods—it is difficult to give an answer either in the affirmative or negative. What can be said is that it is not the ethnic or racial characteristics of the people involved per se. Rather, such factors as the extent to which the neighborhood involved is standard or sub-standard in terms of housing accommodations, the amount of speculation involved on the part of the owners of the real property in the neighborhoods in transition, and the socio-economic status of the newcomers are significant variables. This generalization holds true in terms of property values in the Puerto Rican neighborhoods of Manhattan; according to recent studies it is equally applicable in terms of property values involving other minority groups.[33]

[33] A number of recent studies have been conducted on the subject of realty values in "transition" areas. Among these may be mentioned the following: "The article in the *Residential Appraiser* reports that in Birmingham, Alabama, Negroes moving into run-down areas formerly occupied by whites undertake to repair and rehabilitate the property they have bought, resulting in higher land and home values. It contradicts a long-held belief among many realty men that when Negroes move into an area there is invariably a decline in property values. However, the article points out, if the newly established boundaries of a Negro neighborhood are adjacent to white residential areas, the surrounding area for as much as a mile in radius will experience a diminished volume of realty sales and falling prices." *The New York Times*, August 4, 1957.

In a 1952 article Belden Morgan, an expert appraiser, concluded that "purchases by non-whites have not only maintained price levels but, in many instances, have increased them." Since, in the Los Angeles area of California, the Negro population has been increasing rapidly and since the economic mobility of the Negro has been upward, this trend, he believes, is logical. Belden Morgan, "Values in Transition Areas; Some New Concepts," *The Review of the Society of Residential Appraisers*, March 1952, pp. 45-10.

In another 1952 article, written for the *Appraisal Journal*, L. Laurenti points out that in the years 1949-1951 in San Francisco property changed hands from white to non-white owners at prices generally corresponding to those for comparable properties in all-white areas. He adds that where a small fraction of sales differed by plus or minus amounts, these may have reflected unusual circumstances such as: (1) a premium price extracted from a non-white buyer anxious to get into a particular locality; (2) a sacrifice price agreed to by a seller desirous of dumping property in an area believed by him to be on the verge of rapid deterioration. According to Mr. Laurenti the circumstances mentioned above constituted only *a small fraction of the total sales*. Luigi M. Laurenti, "Effects of Non-white Purchases on Market Prices of Residences," *Appraisal Journal*, July 1952, pp. 314-329.

In a 1954 article in *Land Economics*, Mr. E. F. Schietinger states that human ecologists have often assumed, along with certain partisan groups, that it is possible to make generalizations about the overall effects of given racial or minority groups. He adds that it appears that conclusions regarding the effects of race upon market values are no longer possible, if ever they were, on this level . . . . The extent of identification with particular ends and socio-economic composition of the groups competing for them are variables which cut across racial and ethnic lines. E. F. Schietinger, "Race and Residential Market Values in Chicago, *Land Economics*, November 1954, pp. 301-308.

What this study has brought out is that the migrant Puerto Ricans, having a relatively low socio-economic status, have been suffering both from speculation in housing and from lack of adequate enforcement of existing governmental regulations applicable to housing in New York City. To no small extent, it is these factors which are responsible for relatively low property values in the Puerto Rican neighborhoods compared with property values in one non-Puerto Rican neighborhood and with property values in Manhattan as a whole.

Research on the Physical Form of Cities

The Massachusetts Institute of Technology has established a Center for Urban and Regional Studies, the stated purpose of which is to undertake a unique program of research on the physical form of cities. It will seek answers to such questions as:

Are the great cities of the United States doomed to extinction, or can city planners develop new urban forms that will give our cities new life?

The products of modern technology have greatly complicated life in cities; can we gear our new technology to serve human needs better in the future?

Can we create attractive cities, pleasant to live in, and designed to help different kinds of people live in harmony?

Can a bold new approach in urban research give us new tools with which to fight blight, congestion, and malfunction? Can some of the research techniques of science and technology be applied to the study of cities?

How can the great metropolitan areas of this country cope with the fifty million additional cars the experts predict will be jammed into them by 1970?

What will be the result of such possible breakthroughs in transportation as the development of electronically-controlled highways?

How will such technical possibilities as the economic conversion of salt water into fresh or the chemical disposal of wastes affect the City of tomorrow?

The Natural Gas Supply of California

By JAMES J. PARSONS*

CALIFORNIA is one of the country's major markets for natural gas. Approximately 35 percent of the energy marketed in the state is supplied by gas, compared to 14 percent for the nation as a whole. For most domestic and industrial uses, as distinguished from transportation requirements, it is the paramount fuel. Consumption exceeded one trillion cubic feet in 1957 and would have been higher if more could have been made available during winter demand peaks. Natural gas heats nine out of ten California homes, it supplies most of the fuel for the state's steam-electric plants, it heats the industrial furnaces, and it cooks the food and warms the bath water for most of its 14 million residents.[1]

As recently as 1947 California was entirely self-sufficient in natural gas. Today, a scant ten years later, two-thirds of the gas that is burned in the state (excluding that going to oil-field and refinery uses) comes from Texas and New Mexico by long-distance transmission lines (Map 1). As a result the availability of future supplies of this clean and convenient fuel is becoming a matter of public concern.

California's proved reserves of natural gas at the end of 1956 were estimated at 8.7 trillion cubic feet, or only 3.4 percent of the United States total.[2] This is a notably low figure for a state that traditionally has been considered one of the nation's leading petroleum provinces. Seventy percent of California's meager gas reserves, moreover, occur as "wet" or residue gas and can be produced only as a by-product of oil field operations. Increasingly this gas is being reinjected into the formation to maintain field pressures and to maximize crude oil production. So employed it is unavailable to the market. Field and refinery use of gas, too, has increased sharply as the price of crude oil has crept higher. In mid-1957 crude oil was worth nearly twice as much as natural gas at the well-head on a heat unit basis and gas was being used wherever possible in place of oil.

Deliveries of out-of-state gas to California utility companies were initiated in 1947 by the El Paso Natural Gas Company with the completion of its original 26-inch pipeline from Jal, New Mexico to the Arizona-California boundary at Blythe. Today the El Paso company, still the state's only out-of-state supplier, has the equivalent of five such lines in operation. Glistening white compressor stations, strung out at 35-mile intervals across the Southwestern desert, keep the gas moving. In mid-1957 the company was delivering in excess of 1,700 million cubic feet daily at the Blythe and Topock stations on the Colorado River where the California purchasers receive the gas. By the end of 1958 its deliveries to California will exceed 2,000 million cubic feet daily. In heating value this amount of gas is equivalent to 330,000

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[1] For an earlier study of natural gas in the West see "Western Power and Fuel Outlook, II, Natural Gas," a supplement to *Monthly Review*, Federal Reserve Bank of San Francisco, November 1950, pp. 9-22; also the author's "The The Geography of Natural Gas in the United States," *Economic Geography*, July 1950, pp. 162-78.

[2] American Gas Association and American Petroleum Institute, *Proved Reserves of Crude Oil, Natural Gas Liquids, and Natural Gas in the United States, December 31, 1956*, New York, 1957.

MAP 1. Sources of California Gas Supply: 1956. Each dot represents one percent of total utility company purchases. Solid dots stand for oil-well or residue gas, open ones for dry gas. Solid flow lines indicate movement of gas to California from out-of-state sources; open flow lines show systems supplying other parts of the country which also tap California supply areas.

barrels of petroleum or roughly one-third of the daily production of crude oil from all of the state's oil fields.

This imported natural gas is divided about equally between markets in northern and in southern California. That destined for the northern half of the state, which is served by the Pacific Gas and Electric Company (P. G. and E.), is received at Topock, a few miles south of Needles, and comes largely from the San Juan Basin gas field of northwestern New Mexico. At Blythe, 80 miles downstream, gas from the Permian Basin of West Texas and southeastern New Mexico is delivered into lines jointly owned by the Southern California Gas Company and the Southern Counties Gas Company for transmission to the Los Angeles area. Both Southern California companies are affiliates of Pacific Lighting Corporation, a San Francisco holding company, and the systems are fully integrated. Wholesale deliveries are made to San Diego Gas and Electric Company and, on a lesser scale, to the City of Long Beach. The latter has met most of its needs in the past with residue gas from municipally-owned oil wells, but their output is rapidly declining. A supplementary 30-inch line built by the Southern California companies from the Topock terminal to Newhall, near Los Angeles, brought the first San Juan Basin gas to Southern California in the fall of 1957.

Contracts between the El Paso company and its California customers call for deliveries on an annual basis of not less than 91 percent of the specified maximum daily volume. In practice they run close to 96 percent, the principal curtailments coming on week-ends and holidays when California factories and offices are closed.

Cheap Gas Brings Expanding Markets

Elsewhere the recent, spectacular growth rate of the natural gas industry has been due in an important degree to the displacement of coal, but this has not been so in California. Enormous new energy needs have been created by the unparalled population explosion and associated industrialization of the West. California's population has doubled in the past 17 years and the pace shows no signs of slackening. Natural gas has supplied more than its share of this expanding energy market. Its cheapness as well as its superiority as a fuel have been responsible for its popularity.

In 1956 the average price paid for gas purchased from all sources by the California gas utility companies was slightly under 25 cents per thousand cubic feet (MCF). Delivered to large industrial consumers on interruptible rates it brought an average price of between 33 cents and 37 cents per MCF; small domestic meter rates reached to as high as 90 cents. For industrial users especially, these prices represent bargains in British thermal units. In the San Francisco Bay Area, for example, with the posted price of crude oil $2.85 a barrel, interruptible natural gas was available in mid-1957 for roughly $1.70 on an equivalent basis. Only if the cost of gas exceeded 50 cents per MCF would steam electric plants and other industrial users of gas, which use half of all the gas entering the utility company pipelines, have found it economical to shift to oil in their boilers. Oil producers protest that interruptible gas use lies at the bottom of the problem of the recurrent West Coast fuel oil surpluses.

During the winter months, when domestic consumption is highest, there is insufficient gas to go around. Then the industrial consumers, who are on interruptible schedules, may be cut off and forced to shift to oil on relatively short notice. These interruptible customers, of course, help to provide an important

and valuable stabilizing effect on utility company operations. They provide the demand during the off-peak season that enables the companies to contract for the large volumes of out-of-state gas. Lower rates to firm customers result from the existence of the interruptible market. When, in the past, temporary surpluses have depressed residual fuel oil prices, the Public Utilities Commission of California has permitted the gas utility companies to adjust, within limits, their interruptible rates so that loss of these important markets would not be threatened.[3]

In California two-thirds of all steam-electric plant fuel consumption is natural gas. Gas so used represented almost 20 percent of all gas that entered the pipelines of the state during 1956. The Pacific Gas and Electric Company, unlike the Southern California utilities, operates its own steam plants and is hence its own best customer. During the summer months, when demand for gas for space-heating is at a minimum and electricity demand is high due to irrigation pumping in the Central Valley, P. G. and E. soaks up a major share of its Texas and New Mexico gas imports in its steam generating plants. During the winter these plants, which produce two-thirds of the electricity that the company sells, shift to fuel oil. In southern California, where the electric utility companies are prime customers of the gas companies, electricity demand is much lower during the summer. Here, because of the smog problem, the Air Pollution Control District has asked that natural gas be used in place of fuel oil as far as feasible in all steam plants throughout the year. In both the north and the south, hydro-electric power, once a primary factor in the state's energy budget, has taken a back seat to fuel-based power, supplying less than one-third of the electricity consumed in the average year.

Southern California, in particular, is known as a superior domestic gas market, in part because of the fuel's long history of use in the area and its familiarity to homeowners. Its Pacific Lighting Corporation, with 2,160,000 active meters, is the largest gas distributor in the world. An intensive and highly successful sales promotion program has long been carried on among both tract builders and homebuyers in the Los Angeles area by the gas utility interests. In the north, where P. G. and E. distributes both gas and electricity, competition between energy sources has been less keen. Estimated ratios of sales of major gas and electric appliances during 1956, shown below, demonstrate the extent of the dominance of gas in the southern California domestic market:[4]

	Ratio of Sales in Southern California	*National Ratios*
Kitchen Ranges	8.4 gas to 1 electric	1.6 gas to 1 electric
Water Heaters	73.0 gas to 1 electric	3.3 gas to 1 electric
Clothes Dryers	1.3 gas to 1 electric	1 gas to 2.7 electric

Space heating is almost entirely by gas in both northern and southern California. Gas-burning refrigerators and air conditioners, as yet of minor importance, offer a promising future market for summer gas surpluses that are at present "dumped" at low rates to industrial users.

[3] See, *e.g.* Public Utilities Commission of California Decision 51736, July 26, 1955, and Decisions 51360 and 51361, April 19, 1955.

[4] *Supplement to Annual Report*, Pacific Lighting Corporation, 1956, pp. 8-9.

Dry Gas Fields and Underground Storage Provide Seasonal Flexibility

Northern California dry gas fields provide a convenient regulating device to balance the P. G. and E. system's supply with a seasonally fluctuating demand. An increase or decrease in the output from the Rio Vista field, which accounts for half of the state's dry gas production, can be felt in the San Francisco Bay Area control stations within an hour. On cold winter days Rio Vista goes on the line at its maximum capacity. On week-ends and during the summer months output is sharply reduced. On an annual basis it produces at approximately 60 per cent of capacity. Certain royalty owners recently filed a $150 million damage suit against nine oil and gas companies operating in the field, claiming that the producers, in collusion with P. G. and E. and the El Paso Natural Gas Company, have discriminated against Rio Vista in favor of out-of-state gas, "unreasonably limiting production from the entire Rio Vista field to only a small fraction of its potential."[5] Such an interruptible supply of high-B.t.u. gas is especially valuable when located so close to a major market area. P. G. and E. has recently been paying better than 40 cents per MCF for Rio Vista gas, probably the highest price paid at the well-head anywhere outside of the northeastern states. The Rio Vista price, which does not come under Federal Power Commission jurisdiction, escalates with the posted price of crude oil.

The Southern California companies, lacking similar dry gas fields to "swing on" (the small Trico field in the San Joaquin Valley is their chief local source of dry gas), have turned recently to underground storage to relieve the seasonal imbalance of supply and demand. Two major underground storage projects are now in operation, one the Goleta field near Santa Barbara and the other at Montebello in the Los Angeles Basin. Together they have a capacity of 25 billion cubic feet. Gas injected during the summer months can be withdrawn during periods of heavy demand in the winter at rates up to 900 million cubic feet a day. Close to $60 million is being spent on such storage projects in southern California, although this is but a fraction of that expended on some of the big gas storage projects in the northeastern states.[6] The Goleta field has the disadvantage of being nearly 100 miles from the Los Angeles market area. Montebello is closer, but it took over two years to unitize the project as there were over 400 leaseholders in the area. The southern companies are increasingly turning to agreements with pressure-maintenance projects to take gas during "peaking" periods to avoid such unitization problems. Smaller storage projects, at East Whittier and Playa del Rey, are used as "surge tanks" to equalize daily and week-end market fluctuations in the area, a task that is performed by the dry-gas fields in northern California.

The flexibility of the delivery systems is demonstrated by the experience of the Southern California companies during a particularly cold spell in late January, 1957. On January 29, when light snow fell in southern California (for the third straight day), a record send-out of 1,977 million cubic feet was recorded, despite the shutting off of 516 million cubic feet of interruptible gas to industrial users and utilities.[7] For the state as a whole maximum daily availability of gas from all sources to meet peak

[5] "Monopoly Charged: Rio Vista Royalty Owners File $150 Million Gas Suit," *Oil and Gas Journal*, April 29, 1957, p. 115.

[6] "Gas Storage is Big Business," *Oil and Gas Journal*, May 27, 1957, pp. 88-92.

[7] *Gas News*, Southern Counties Gas Company, February 26, 1957.

demand during the winter of 1957-58 is estimated at 4,756 million cubic feet (Table I). Under the most extreme

TABLE I—ESTIMATED PEAK DAY GAS SUPPLY AVAILABLE IN CALIFORNIA: 1957-58 WINTER SEASON
(*Millions of cubic feet*)

	Southern California	Northern California	Total State
From California:			
Oil-well Gas (Regular).....	552	120	672
Dry Gas.....	43	822	865
Oil-well Gas (Emergency).....	164	37	201
Underground Storage	952	.....	952
Stand-by (Manufactured) ..	3	126	129
From Out-of-state.....	966	971	1,937
	2,680	2,076	4,756

Source: Report to the Public Utilities Commission of the State of California on the availability of, and demands for, gas in California, Years 1956-58, prepared by representatives of the principal gas utility companies. Case 5924, Exhibit 5924-7, June 24, 1957.

weather conditions postulated "firm" requirements would take all but 600 million cubic feet of this and interruptible customers would have to be curtailed to the amount of 1,925 million cubic feet. These estimated requirements for extreme peak days are based on assumed average temperatures of 36° F for the Southern California and Southern Counties Gas Companies' service areas, 40° F for that of San Diego Gas and Electric, and 29.1° F for P. G. and E'.s northern California system. They represent extreme conditions that would not be expected to recur more than once in 20 years.

The Southern California Edison Company, principal supplier of electric power to the southern part of the state and the largest single customer of the gas utility companies, has recently proposed to build its own, 130-mile trans-Tehachapi gas pipeline from Richfield's North Cole's Levee field in the San Joaquin Valley to Los Angeles. A non-interruptible residue gas supply would thus be made available to its Wilmington steam plant. The southern California gas companies have protested, claiming (a) that in-state gas resources should be reserved for home heating and (b) that diversion of one large block of in-state gas to the exclusive use of a steam generating company would be both wasteful and unfair to other users whose volume must be reduced during peaking hours. The Edison Company, on the other hand, emphasizes that it will be contributing to the solution of the smog problem if it uses more gas and less fuel oil. On this ground it has also objected to the gas companies' request to divert part of the load of the new Topock-Los Angeles gas line to a large Victorville cement plant 100 miles east of Los Angeles in the desert, contending that the gas would be more wisely used in the Los Angeles Basin to cut down the smog menace.

As a further step in the direction of obtaining a more reliable source of gas for its boilers Southern California Edison Company has also contracted directly with El Paso Natural Gas Company, subject to Public Utilities Commission and Federal Power Commission approval, for delivery at Topock of 100 million cubic feet of gas a day by the end of 1958, increasing thereafter to 300 million cubic feet. The gas would be transported to the company's Los Angeles area steam plants through the gas companies' new line on a fee basis, with up to 8⅓ percent of the annual volume being made available to Southern California Gas and Southern Counties Gas to meet winter peaking loads at 58.5 cents per MCF. The city of Los Angeles has objected, claiming that such an arrangement would give the electric utility com-

pany a preferential fuels position as against industrial users.[8]

The Public Utilities Commission has deferred approval of both the North Cole's Levee line and the contract with the El Paso company pending the results of an overall investigation (C 5924) into the present and potential adequacy of the gas supply of the entire state. Such an investigation will include a consideration of the question of priority of service between industrial and steam plant users.

The El Paso Natural Gas Company in the Economy of the West

As California's dependence on imported gas has increased, the role of the El Paso Natural Gas Company in the economy of the West has grown proportionately. With assets totaling more than one billion dollars it has become in the space of a few years one of America's new corporate giants. Founded in 1928 to supply the city of El Paso, Texas, with natural gas from the recently discovered Lea County dry gas fields in New Mexico's southeast corner, it was a relatively modest operation until 1947. Then with the laying of the first pipeline to California, "the lid blew off." The company since has been feverishly engaged in laying additional pipelines, looping existing ones, and adding compressor stations to meet the insatiable requirements of the West Coast market.

In addition to the California purchasers, who take almost three-fourths of the gas entering the El Paso system, the company supplies gas to El Paso, Phoenix, Tucson and numerous smaller communities in New Mexico and Arizona. The copper companies along its original "South Line," including the Cananea mine in Mexico, are among its major customers. Another is the Nevada Natural Gas Pipeline Company which serves the Las Vegas-Boulder City area. Here, in two handsome new steam plants only a few miles from the great Hoover Dam power complex, natural gas is being used to generate one-third of southern Nevada's electric power needs. The reason? Gas is cheap, and there is insufficient Hoover Dam power available.

In 1950 El Paso began supplementing its Permian Basin supplies, originally purchased for as little as 2 cents per MCF, with gas from the San Juan Basin. For a time gas from the Texas Panhandle also reached the West Coast, but since 1953 the Company's Panhandle gas has been traded out to Northern Natural Gas Company, which serves the Minneapolis-Omaha area, in return for a like amount of gas delivered to El Paso from Northern Natural's Permian Basin production. The original southward flow in El Paso's Panhandle line, built in 1948 to meet California demands, has been reversed and the line now carries additional gas owned by a Northern Natural subsidiary on a fee basis, from the Permian Basin northward.

In 1956 the El Paso company paid an average of 10 cents per MCF for Permian Basin gas, including both clean dry gas and residue gas scrubbed of its impurities. In the San Juan Basin, during the same period, the average price was 11 ½ cents.[9] Most contracts have escalator clauses calling for automatic price increases of at least one cent per MCF at five-year intervals. Any such price increases are automatically passed on to West Coast consumers. Competitive bidding for uncommitted gas reserves is exerting an upward pressure on field prices in the Permian Basin. The El Paso company, once the only bidder for the residue gas

[8] "Pipeline Fight Flares," *Oil and Gas Journal*, July 8, 1957, p. 80.

[9] *Prospectus, El Paso Natural Gas Company 5.68% Cumulative Preferred Stock*, March 19, 1957, p. 15.

of West Texas, now faces competition from both Northern Natural, through its Permian Basin Pipeline Company subsidiary, and the Pioneer Natural Gas Company, which serves Amarillo and the deep-pumping irrigation districts of the Texas High Plains.

San Juan Basin gas, which once found its only out-of-state market in California, now also goes to the Pacific Northwest and, if one plan before the Federal Power Commission is approved, may eventually find its way to the Chicago market. By its recent acquisition of the Pacific Northwest Pipeline Corporation the El Paso company has at least temporarily regained control of all out-of-state competition for San Juan gas. In July 1957, however, a newly formed Trans-Western Pipeline Company announced plans to build a new line from this area to California. Initial delivery capacity would be 200 million cubic feet daily. Reserve commitments are being sought both for dry gas and residual gas from the new oil fields in the isolated Utah portion of the Four Corners area. It has been speculated that this new line, if built, may make direct delivery at the California state line to a major industrial or electric utility customer, thus by-passing the gas utility companies and avoiding Federal Power Commission regulation of the price of the gas.[10]

Regulated or Free Market Prices?

The field pricing of natural gas is currently a matter of political controversy in Washington.[11] The Natural Gas Act of 1938, as interpreted by the Supreme Court in the Phillips Petroleum case, appears to require direct Federal Power Commission regulation of the well-head price of all gas sold into interstate commerce. The industry-supported Harris-O'Hara Bill would assure producers a "reasonable market price" for their gas, explicitly ruling out the utility-type regulation of prices based on "costs plus a fair return." It argues that the finding of gas, like the finding of oil, is a risk-taking enterprise in which the allocation of cost in each individual case is quite impractical. But it faces strong opposition from consumer groups.

There is a good argument for higher field prices of natural gas. More than anything else they would stir venture capital to search for new reserves, for continuing new discoveries are necessary if the growing demand is to be met for more than a few years. At present it is said to take from three to ten years for a gas well to "pay out" as against 18 to 25 months for a good oil well. The big money is still in oil, but with higher prices gas will increasingly be sought by wildcatters for its own sake.

Price regulation and the threat of price regulation have tended to give natural gas an unnatural advantage in the market place in competition with other sources of energy. As a result this preferred fuel, for which many are willing to pay a premium price, is being sold for "inferior" industrial uses to the extent that a "tight" supply situation may be prematurely threatened. But higher gas prices clearly lie ahead. A recent indication of this is the Federal Power Commission's reluctant approval of a sales contract for a huge block of gas in the Louisiana tidelands at 21.4 cents per MCF, probably the highest well-head price yet paid by a major pipeline company for gas on the Gulf Coast. Rising steel costs and the higher interest rates being paid for bond money, too, are forcing transmission costs up. At the

[10] "More Gas to Go West," *Oil and Gas Journal*, July 8, 1957, p. 75.

[11] Marshall C. Howard, "Regulation and the Price of Natural Gas." *Southern Economic Journal*, October 1956, pp. 142-50. James W. McKie, *The Regulation of Natural Gas*, (Washington, D. C.: American Enterprise Association, 1957).

same time the gas utility companies, faced with rising money costs, are beginning to ask regulatory bodies for a 6½ percent rate of return on their invested capital in place of the historic 6 percent.

The Permian Basin of West Texas and New Mexico

The Permian Basin is one of America's richest petroleum provinces and it is still expanding after 30 years of feverish activity.[12] Except for six dry gas fields in the Jal area of New Mexico its gas is all residue gas produced in conjunction with oil-field operations. The El Paso Natural Gas Company with connections to 47 gasoline extraction plants supplied by 23,150 oil wells, takes possibly four-fifths of the gas available for sale in the area. Its largest single outside supplier is the Phillips Petroleum Company.

In 1956 the aggregate volume of Permian Basin gas taken into the El Paso company's system, in millions of cubic feet, was reported as follows:[13]

Residue gas purchased in Texas...	284,663
Residue gas purchased in New Mexico.....	78,853
Residue gas from company-owned extraction plants in Texas and New Mexico.....	91,465
Dry gas purchased, primarily in Lea County, New Mexico.....	157,212
Dry gas produced by company....	6,250
	618,443

Of this gas probably two-thirds eventually reached California markets; the remainder was sold to customers along the route of the "South Line" or used in compressor station operations.

All of the Permian Basin residue gas, save that from the Spraberry Trend area east of Midland, Texas, is sour gas that must be scrubbed clean of sulfur dioxide and carbon dioxide before entering the transmission lines. The development, in 1946, of a process for sweetening this gas through the joint efforts of the El Paso company and the Fluor Corporation greatly expanded the supplies available to pipeline companies and helped make possible the extension of the El Paso system to California. Previously the company had depended chiefly on dry gas from the Jal fields to service its southwestern markets. Most of the residue gas produced in the region had been either flared or utilized in carbon black plants. With the coming of a major pipeline outlet to the West Coast in 1948 the situation changed. Flaring of gas has ceased and the soot-encrusted carbon black plants are closing down because they cannot pay the higher price that gas is now bringing. A new process for making carbon black from crude oil has helped make this possible.

The El Paso company obtains more of its gas (55 percent) from oil wells than any major interstate transmission company. Virtually all of this comes from the Permian Basin fields. The availability of such residue gas to the company is dependent directly upon the amount of petroleum that is produced. This is determined by market demand, as interpreted by the state proration authorities. When the Texas Railroad Commission cut Texas allowables from 15 days to 13 days in July 1957, deliveries of gas to El Paso's lines declined by 100 million cubic feet. The deficiency had to be made up from New Mexico sources. Again, most oil producers complete their allowable "take" several days before the end of the month to be on the safe side in case of a break-down. Thus, in the last few days of any month the availability of residue gas declines significantly. The El Paso company may lose as much as 200 million cubic feet in this way, but

[12] L. J. Logan, "What's Ahead in the Permian Basin," *World Oil*, June 1957, pp. 120-23.

[13] Prospectus, *El Paso Natural Gas Company 5.68% Cumulative Preferred Stock*, March 19, 1957, p. 12.

here again the dry gas fields are available to "swing on." In 1956, for instance, daily deliveries from the 570 dry gas wells in Lea County, New Mexico, tied to the El Paso system ranged from a high of 680 million cubic feet a day to a low of 136 million cubic feet. Although deliveries to California proceed at a more or less even pace through the year, there is a seasonal fluctuation of 100-150 million cubic feet a day between summer and winter on the "old system" to customers in Texas, New Mexico and Arizona and through-out must be further adjusted to meet this condition.

Finally, in the Permian Basin, as elsewhere, there has been an increasing tendency on the part of oil producers to reinject residue gas back into the formation in pressure-maintenance, "gas drive," or cycling operations.

The residue gas, when first removed from the oil at the well-head scrubber, contains not only sulfur and carbon dioxide but lighter liquid fractions (propane, butane, etc.) known as liquid petroleum gasses (LPG's). These LPG's are extracted in gasoline absorption plants, leaving pure methane (CH_4) to go into the pipelines. The El Paso company produces a million gallons of these liquids daily in the five gasoline plants it owns in the Permian Basin.

The San Juan Basin Gas Fields

Prior to 1950 the gas-bearing formations underlying the isolated upper San Juan river valley east of Farmington had been developed only to serve local New Mexico markets. Between that year, when the El Paso Natural Gas Company entered the area, and the present the San Juan Basin has been metamorphosed from a lonesome land of sagebrush and juniper into a busy oil and gas frontier.

From a dusty agricultural marketing center (population 3,572 in 1950) Farmington has grown in seven years to a city of 18,000 inhabitants. Its streets are overcrowded, schools are on half day sessions, and an estimated one-third of its population lives in mobile homes. Farmington has been called the "Trailer Capital of the Southwest." It is the regional headquarters and service center for more than one hundred oil and gas drilling and equipment companies although its only rail connection is a branch of the Denver and Rio Grande's fabled Alamosa-Durango-Silverton narrow-gauge line on which abandonment procedures had been instituted shortly before business turned up. Heavy-duty trucks and trailers, rumbling in nightly from Denver, Albuquerque and Gallup, bring the area most of its supplies. At least twelve commercial passenger flights arrive and depart daily from the busy new Farmington airport on the mesa above the city. Farmington, like booming Las Cruces in the south, aspires to be the second city of New Mexico.

The initial 450-mile, 24-inch line built from the San Juan Basin to California in 1950 was to be supplied by the Barker Dome field, a high-pressure salt dome structure on the Colorado-New Mexico boundary producing from a Pennsylvanian (Paradox) formation. Barker Dome proved to be a highly localized structure, however, and is today a minor producer with pressure already reduced to half of the original figure. It was, instead, the fortuitously rapid development of the vast cretaceous dry gas formations (Mesa Verde and Pictured Cliffs) east of Farmington that was to insure a gas supply for the new California lines and to remake the economy of the region.

The gas-producing area of the San Juan Basin covers an area nearly 120 miles long by 60 miles in width. Eleven separate fields or structures are recog-

nized, aligned *en echelon* and running from northwest to southeast as a succession of ancient shorelines. The Blanco field is much the largest, with better than one million productive acres. The producing horizons are shallow and pressures are relatively low. Extension of the limits of the gas-producing area continues, especially at its eastern margin. Production from deeper horizons is also anticipated. There has been little drilling below the 5,000-foot Mesa Verde level as yet although the granite basement may be as deep as 15,000 feet in places.

Both the Mesa Verde and Pictured Cliffs sandstones are of uncommonly low permeability and delivery capacity varies considerably from well to well. Extraordinary success has been achieved recently through hydraulic fracturing, a process whereby the tight producing strata are fractured by a water and fine sand mixture forced into them under very high pressures and at high velocities. The resulting force parts the rock layers in much the same manner that the leaves of a book are parted by blowing a strong wind against them. The sand remains in place to prop open the tiny crevasses or fractures, thus allowing freer migration of gas into the well. Although costs may reach as high as $30,000 per well, hydraulic fracturing is paying out. Potentials of wells being completed in the San Juan Basin by this method run about twice the potential of comparable wells completed in the past by standard procedures. In exceptional cases the daily delivery potential may be increased tenfold or more. Whether the new method will make wells produce more gas during the lifetime of the field, or only cause the gas to be produced more quickly, is not entirely clear. Most observers, however, see San Juan Basin reserves estimates being revived substantially upward as a result of this development.

San Juan Basin gas, save that from Barker Dome, is a sweet, dry gas containing relatively small amounts of liquid fractions. Most of the LPG's removed go by a special liquid pipeline to a new El Paso-owned fractionating plant near Gallup, New Mexico.

The El Paso Natural Gas Company takes gas from some 1,900 wells in the San Juan Basin. Nearly half of these it owns outright. In addition it has some 193 private contracts for gas purchase, the largest outside supplier being the Delhi-Taylor Oil Company. Much San Juan Basin production is from state and federal lands for, except for the irrigated river margins and a narrow strip of dry-farmed pinon-juniper land in the Ignacio district of Colorado, the area is largely a desert waste where water may be more difficult to find than gas. There is also substantial production from Jicarilla Apache, Ute and Navajo Indian Reservation lands. The monthly output from each well is determined by the New Mexico Oil Conservation Committee, which prorates production on an acreage times deliverability factor. An output of roughly 60 percent of potential is currently sufficient to meet the needs of the pipelines.

In 1956 San Juan Basin gas supplied slightly more than half of the El Paso company's deliveries to P. G. and E. at Topock. When the expansion program now underway is completed it will supply three-fourths of the Topock deliveries or better than 700 million cubic feet daily. The original line has been paralleled by another and this in turn is now being looped by yet a third line. North of Gallup these lines are joined by a 30-inch cross-over line, completed in 1953, which brings Permian Basin residue gas into that part of the "North Line" that crosses the state of Arizona.

The route of these pipelines from the San Juan Basin to California, as well as the cross-over line from the Permian Basin, passes through an area noted for its archeological riches. Some 218 miles of the San Juan-Topock right-of-way lie within the Navajo Indian Reservation. During the construction of these lines teams of trained archeologists were employed at the company's expense to carry out a survey and salvage program in the wake of the huge trenching machines. A total of 312 sites were discovered of which 44 were excavated, and a 400-page report of the findings has been published.[14] This cooperative venture between industry and science set a precedent in "salvage archeology" that has been followed by other pipeline companies and, more recently, by several state highway commissions.

The Pacific Northwest Pipeline Controversy

In the winter of 1955-56 San Juan Basin gas, hitherto marketed only in New Mexico and California, began moving through the newly-formed Pacific Northwest Pipeline Corporation's "Scenic Inch" pipeline into Washington and Oregon, with lesser amounts to Utah, Colorado and Idaho outlets. As of early 1957 the 1,482-mile line, reaching to Sumas, Washington, on the Canadian border, had a daily delivery capacity of 343 million cubic feet. This is to be doubled by 1959. Most of Pacific Northwest's gas comes from the Colorado side of the San Juan Basin where the company owns oil and gas leases totaling more than 300,000 acres. Lesser amounts of gas are picked up from smaller fields along its right-of-way in Colorado, Utah and Wyoming (e.g., Piceance Creek, Rangely, Big Piney and Bar-X.)

Early in 1957 the El Paso Natural Gas Company, through a stock transfer, acquired control of Pacific Northwest Pipeline. It has since become its "operating agent" in the San Juan Basin. Not only has a major factor in the competition for the gas of the basin thus been eliminated, but in this deal El Paso has obtained important rights to Canadian gas reserves and a controlling interest in a new gas line (West Coast Transmission Company, Ltd.) from the Peace River fields of British Columbia and Alberta to the United States border at Sumas. Deliveries by West Coast Transmission to Washington markets, scheduled to begin during the winter of 1957-58 at an initial rate of 200 million cubic feet daily, will reach 400 million cubic feet by 1959.

Canadian sources, if they develop as anticipated, should eventually be capable of supplying the entire Pacific Northwest area's demand for natural gas, thus freeing the San Juan Basin gas committed to Pacific Northwest Pipeline Corporation for California markets. The direction of flow in the San Juan-Pacific Northwest line could eventually be reversed to carry surplus Canadian gas to the El Paso company's California lines. These, however, are already nearing the saturation point and a more direct line across the Great Basin to the California border seems more probable.

The Justice Department, in a suit filed in July, 1957, in the U. S. District Court at Salt Lake City, (C-143-57 *U. S.* vs. *El Paso Natural Gas Co., et al.*), has demanded that El Paso divest itself of its Pacific Northwest Pipeline holdings.[15]

[14] Fred Wendorf, Nancy Fox, and Orian Lewis, editors, *Pipeline Archeology* (Santa Fe and Flagstaff: The Laboratory of Anthropology and The Museum of Northern Arizona, 1956).

[15] "Antitrust Suit Filed Against Pipeline Merger," *Wall Street Journal*, July 23, 1957. The Federal Power Commission has been petitioned to approve the merger. Should it do so it is possible that the courts would hold the company to be immune from antitrust action. Section 7 of the Clayton Act provides, among other things, that "nothing contained in this section shall apply to transactions duly consummated pursuant to authority given by the . . . . Federal Power Commission . . . . under any statutory provision vesting such power in said commission." Extended legal proceedings, possibly lasting through several years, are anticipated before matters involved here are resolved.

The government charges that the merger may lessen competition for gas in the San Juan Basin and other Rocky Mountain areas as well as eliminate potential competition between the two companies for the lucrative California market. The California attorney general had made a similar complaint earlier in the year. In the suit the Justice Department states that El Paso possesses more gas reserves than any other pipeline company, that it is the sixth largest natural gas producer in the country, and that in 1955 it supplied California with more than 60 percent of its gas needs. The merger is claimed to make the West "almost entirely dependent on one company for the purchase and sale of natural gas."

Paul Kayser, President of the El Paso Natural Gas Company, in answering the charges has declared that access to the reserves obtained through the merger "is urgently needed by El Paso to meet the growing demands of its markets in California and other points on the system." He stated that his company is now planning the delivery of 500 million cubic feet daily of additional gas to these markets, a large part of which would come from these new sources.

A break-up of the merger would presumably lead to a renewal of an earlier Pacific Northwest proposal to build a line direct to California. El Paso, with substantial Canadian reserves of its own, might have an incentive to build its own line from Canada southward.

Paradox Basin Developments

The extraordinary rate of growth of Farmington and the San Juan Basin undoubtedly would have slowed its pace by now were it not for the fortuitous discovery of what promises to be a major oil province in the Paradox Basin of the Four Corners area. This lonely desert tract lying mostly within the limits of the Navajo Indian Reservation, is currently one of the most active drilling areas on the continent and already one major field, Aneth, has been outlined in southeast Utah. In the summer of 1957 more than 100 drilling rigs were in the area. Although it is at least 70 miles from the center of Paradox Basin activity, Farmington is the headquarters for the majority of service and supply firms serving this promising new oil region.

A crude oil pipeline to Los Angeles, to be completed early in 1958, will permit daily shipment of 60,000 barrels of Paradox Basin oil compared to the 4-5,000 barrels being trucked out in the summer of 1957. A branch of the new line will tap the Bisti field on the southern margin of the San Juan Basin of New Mexico. Aneth and Bisti together promise to provide significant supplementary supplies of residue gas for the El Paso and Pacific Northwest Pipeline systems, and perhaps others, in the near future. In December 1957 El Paso requested FPC authorization to take 115,000 cubic feet of residue gas daily from the Aneth field for its California lines. Enthusiasm for the future of the Four Corners area is running high. Some even see it as another West Texas. It seems apparent, at least, that it will contribute significantly to California's gas supplies in the near future.

Recent discoveries at several widely separated points in the Paradox Basin suggest that substantial quantities of dry gas, as well as oil-well gas, may eventually be found in the area. One of these wells lies just inside the Arizona boundary and represents the first oil or gas well ever completed in that state.

California Gas Production

The rising tide of gas imports in the face of higher prices reflects California's inability to meet its own tremendous needs. Net withdrawals of gas from the

state's wells in 1956 totaled 486 billion cubic feet, of which 141 billion was dry gas and 345 residue gas. The latter figure has been declining in step with that for crude oil output. While total U. S. reserves of gas were up 14.1 trillion cubic feet in 1956, a record increase, California withdrawals during the year again substantially exceeded new discoveries. And these withdrawals satisfied scarcely one-third of the state's demand.

Oil field operators have probably been more reluctant to sell their residue gas to pipelines in California than in other, flusher producing states where pressure maintenance and secondary recovery practices are less developed. Reinjection of residue gas into oil-bearing formations totaled 236 billion cubic feet in 1955, equivalent to almost half of the combined net withdrawals of dry and residue gas during the year. Almost all of these projects were in the San Joaquin Valley.

Increasing field and refinery usage of natural gas for fuel further restricts the marketable supplies. Use of gas as a raw material for petrochemicals manufacture, on the other hand, is developed but little in the state.

Natural gas in California has had a considerable history. It seems first to have been discovered while drilling for water on the grounds of the Stockton courthouse in 1854-55.[16] This gas had been in use for some time before Col. E. L. Drake drilled the country's first oil well in Pennsylvania in 1859. Other gas discoveries followed, chiefly in the San Joaquin Valley, but first commercial utilization on a substantial scale did not occur until 1886 in Stockton and 1907 in Santa Maria. Thereafter natural gas began to replace manufactured gas in one city after another. In 1910 Bakersfield began receiving gas from the Midway-Sunset oil field, 40 miles to the west. Three years later another line was built from the same source to supply the Los Angeles area. By 1927 most of the communities of southern California were served by natural gas.

Discovery of the Buttonwillow dry gas field in Kern County in 1926 led to the construction of the first gas pipeline to the San Francisco Bay Area, completed in 1929. Buttonwillow was a disappointment, but before the "Bay Line" was in full operation the Kettleman North Dome discovery had provided residue gas in much larger amounts than the market could absorb. This, and a number of other high gas-oil ratio discoveries in the deeper zones at Santa Fe Springs, Long Beach and Ventura, led to such extravagant waste of gas that during the summer of 1929 it was estimated that one billion cubic feet were being flared each day.[17] Although the role of gas in oil production was still but dimly perceived, legislation to prohibit unreasonable waste was passed by the state legislature in that year and was gradually accepted by the industry. Gathering lines were extended to almost every field in the state and a dense network of large and small diameter transmission lines came into being to serve the sprawling California market.

Dry gas fields in the Sacramento-San Joaquin Delta and in the Sacramento Valley today account for something less than 30 percent of the state's estimated gas reserves and about the same share of its total gas production. The giant Rio Vista field, discovered in 1936 in the Delta area some 40 miles northeast of San Francisco, is rated as one of the dozen most important natural gas fields in the United States. But the drain on

[16] D. E. Ritzius, "Oil and Gas in California—A Primer," *Summary of Operations, California Oil Fields*, January-June 1956, pp. 4-42. reference pp. 36-37.

[17] E. Huguenin, "History of Gas Conservation in California," *Summary of Operations, California Oil Fields*, January-June 1945, pp. 3-18.

it has been heavy and its original three billion cubic feet of reserves is more than 60 percent depleted. Nevertheless it still accounts for more than half of California dry gas production and dry gas reserves.[18]

The high premium being paid for dry gas in northern California has recently encouraged much wildcatting for gas in the Sacramento Valley and new dry gas discoveries have been substantial. In 1956 some 54 dry holes and 35 producers were drilled in the valley, the largest number in Glenn County. Largest of the Sacramento Valley fields is Beehive Bend, in the Willows area 80 miles north of Sacramento. In April 1957, production from Beehive Bend was at the rate of 40 million cubic feet a day and reserves were estimated at better than 100 billion cubic feet with the area about half developed.[19] These new dry gas fields, which supply much of the valley market, are being tied to Eureka, on the north coast, by a 173-mile, 12-inch diameter pipeline to be completed in 1958. Eureka has been supplied by the nearly depleted Tompkins Hill dry gas field, which lies nearby, since 1940.

Future Gas Supplies for California

How are California's future requirements for natural gas to be met if its unbridled economic growth continues? A recent study by the Chase Manhattan Bank estimates that consumption of natural gas in the five Western States will increase 86 percent in the next decade.[20] For California a doubling of imports to a level of perhaps 3,500 million cubic feet daily seems reasonable if the gas can be made available at competitive prices. In another study the bank's economists state their belief that it can, and estimate that 80 percent of the ultimate natural gas supply of the United States has yet to be discovered.[21]

A recent report by an independent engineering consultant firm[22] indicates that in August 1957 the El Paso Natural Gas Company (including its Pacific Northwest Pipeline Corporation subsidiary) had committed to it 32.5 trillion cubic feet of reserves in fields in the southwestern United States. Of this, 10.7 trillion cubic feet was represented by residue gas from Permian Basin gasoline extraction plants and another 1.5 trillion cubic feet was committed under a special gas purchase contract with Phillips in the Panhandle field. The remaining 20.3 trillion cubic feet was in the form of dry gas reserves either owned or committed, the reserves being reported as 55 percent developed and 45 percent undeveloped. They included 5.9 trillion cubic feet held by Pacific Northwest Pipeline, mostly in the San Juan Basin. As against these figures total annual requirements of the El Paso system in 1957 were reported as slightly in excess of one trillion cubic feet.

The Federal Power Commission normally demands proof of a 20-year supply of gas before it authorizes transmission line construction or expansion of existing capacity. In the spring of 1957 the FPC stated in effect that, based on the record before it, the El Paso company could maintain a balance after 1958 between its controlled supply of gas and expected needs only by assuming substantial reductions in deliveries to its California customers and the abandonment of direct sales to Arizona and New Mexico copper

[18] *Summary of Operations, California Oil Fields*, January-June 1956, p. 80.

[19] "Shut-in Gas Gets Relief," *Oil and Gas Journal*, April 29, 1957, pp. 114-15.

[20] "Trouble in the West," *Oil and Gas Journal*, May 27, 1957, pp. 100-01.

[21] They estimate that peak production will come between 1980-1990, when it will reach 20 trillion cubic feet per annum or double the present marketed production. "Gas Industry Still Has Growing Room," *Oil and Gas Journal*, July 29, 1957, pp. 110-11.

[22] "Report on Gas Reserves" by Brokaw, Dixon and McKee, Engineers and Geologists, in *Prospectus, El Paso Natural Gas Company 5¼% Convertible Debentures Due September 1, 1977*, August 21, 1957, pp. 16-19.

companies as its present commitments expire, beginning in 1959. The Commission further stated that a serious problem faces the company with respect to its ability to meet the needs of its customers and that, in the certificate proceedings to begin in July 1957, the company would have to present a program for meeting its future system requirements. The company has expressed confidence that it will be able to develop and obtain new sources of gas in sufficient quantity to supply its expanding markets. Deeper drilling in the Permian Basin is turning up substantial Pennsylvanian and Devonian production. In the San Juan Basin the shallow Pictured Cliffs horizon that overlies the Mesa Verde is proving productive in many new areas, enforcing a substantial upward revision of reserve estimates. The company is actively developing properties on the Louisiana Gulf Coast probably for trade-out purposes. On the southwestern margin of the Texas Panhandle gas field, and extending into Oklahoma, it has recently acquired gas rights to 178,000 semi-proved acres that are expected eventually to provide a daily delivery of 300-500 million cubic feet of gas. Its acquisition of the Pacific Northwest Pipeline Corporation has provided it with another five trillion cubic feet of reserves, mostly in the San Juan Basin, either owned or under contract. In addition, through its own leases and through those of subsidiaries, El Paso controls substantial gas reserves, and is actively seeking others in British Columbia and in Alberta.

The Importance of Canadian Gas

The new Canadian gas fields are clearly destined to play an important role in supplying California with its ballooning natural gas requirements. Discoveries of both oil and gas in Alberta and in the Peace River country of British Columbia have reached major proportions. In September 1956 proved reserves were officially listed at 18.3 trillion cubic feet for Alberta alone and the Alberta Petroleum and Natural Gas Conservation Board projects disposable reserves to 42 trillion cubic feet within the next 30 years.[23] The significance to California of the El Paso company's acquisition of control of the West Coast Transmission Company Ltd., which began carrying Peace River gas to Washington in late 1957, has already been mentioned. Another line from the Savanna Creek gas field in southern Alberta has been proposed that would tie in with the Pacific Northwest Pipeline system just south of the international border, deliveries to be at the rate of 250 million feet a day for a 20-year period beginning in late 1959 at an initial delivery price of 25 cents per MCF. Canadian permission to export the gas is required.

In June 1957 the El Paso company and the southern California gas companies jointly announced a proposal to bring the first Canadian gas directly to California. According to their plan which awaits approval of various governmental agencies El Paso would build a new line from the Pacific Northwest Pipeline Corporation's trunk in the vicinity of Twin Falls, Idaho, to a point on the California-Nevada state line in the vicinity of Las Vegas for delivery to the southern California companies. The plan calls for delivery of 400 million cubic feet of Canadian gas daily for 20 years, beginning in the fall of 1958, at an initial price of 38.1 cents. The price, if it sticks, would be better than 50 percent above the present delivery price for Permian Basin gas at the California border and

[23] Floyd K. Beach, "Canadian Gas Developments," *World Petroleum*, May 1957, pp. 70-71 ff.

provides further proof that the era of cheap gas is fast disappearing.

More recently P. G. and E. has announced its own private plan to build a 1,300-mile transmission line from Alberta to its present gas control station at Antioch, near San Francisco. The line, to be built by a new subsidiary known as the Alberta and Southern Gas Company, Ltd., is expected to have an initial delivery capacity of 400 million cubic feet a day. Gas supplies in this amount are said to have been contracted for beginning in 1960. One half of whatever amount of gas is brought into the state is to be offered to the southern California gas companies. Again, Canada must decide if its own long-term interests permit the large-scale export of its abundant gas southward across the border. As new discovery has followed new discovery the once cautious policy on gas exports, based on the fear that it might be squandering for a pittance the basis for the industrialization of the Prairie provinces, has seemed less and less realistic. Yet an underlying feeling of skepticism about Canadian benefits from large scale exports of gas to the United States under present conditions persists and a Royal Commission on Energy policy is currently reviewing the entire problem.[24] Most observers expect that requests for gas export licenses to the West Coast will receive favorable attention from provincial authorities if the price offered seems adequate.

Liquification of gas at low temperatures (—250° F) has been suggested from time to time as a way to bring surplus gas from Venezuelan and Middle Eastern oil fields to North American and European markets. Although technical barriers are gradually crumbling it remains an extremely dangerous as well as costly process. However, with by-product credit for refrigeration produced in re-gasification it might someday become competitive with domestically produced gas from pipelines.

Finally, there is manufactured gas produced from crude oil. It has a much lower heat value than natural gas and is also costlier. Although manufactured gas has not been produced in Los Angeles since 1928 there are still stand-by plants in operation in San Diego and in the San Francisco Bay Area. One day, when sufficient natural gas to fill the pipelines is no longer available, the vast, low-grade coal deposits in the San Juan Basin and in the Rocky Mountains may be gasified in place and sent on their way to distant markets. The product would be a poor, but perhaps by then acceptable, substitute for the pure methane to which we have become accustomed.

High Load Factors or High Prices?

The California economy has derived much of its past strength from the availability of cheap and abundant energy. Today the state's accelerating rate of oil and gas consumption can no longer be supported by in-state production. Tankers are able to lay down crude oil from overseas sources at little increase in cost but it is another matter with natural gas, which can be moved only by pipeline. A substantial adjustment in the state's energy budget may be forced upon it well before the vision of ample low-cost atomic power is realized. Thoughtful persons inside the California gas industry and out are concerned both as to where the gas will come from 25 years from now and how much it will cost. It may yet seem advisable to adjust out-of-state deliveries to the seasonal demands of "firm" customers. This would be more practical in the case of dry gas than for Permian Basin oil-well gas where

[24] *The Financial Post*, Toronto, Canada, December 7, 1957.

resort would have to be made to large-scale underground storage projects.

The cost of long-distance transmission of gas in large diameter pipelines with high load factors is estimated to be about 1.5 cents per MCF per 100 miles.[25] On this basis San Juan Basin-to-San Francisco or Permian Basin-to-Los Angeles charges would amount to about 17 cents. At present this represents about half the cost of gas to large volume interruptible customers, but a much smaller share of the cost to domestic users. Higher prices, whether the result of lower summertime load factors or higher well-head costs of gas, would tend to reduce industrial consumption and channel this preferred fuel more and more to space-heating, household, and specialized manufacturing uses. While a reduction of summer deliveries would lift average per unit transmission costs substantially, the life expectancy of the natural gas-reserves accessible to the California market might thus be prolonged into the next century.

[25] Richard J. Gonzalez, "The Price of Natural Gas," *Southwestern Social Science Quarterly*, December 1956, pp. 257-70.

Methods of Compensating Land Owners for Damages Attributed to Public Control of Water Levels; A Case Study of the Islands in Lake Okeechobee, Florida†

By R. L. LASSITER, JR.* and W. K. McPHERSON**

PROBLEMS associated with just compensation of individuals for damages incidental to public water control projects present a conflict of interests that appear to be irreconcilable. Administrators of these projects are usually charged with responsibility to the taxpayers supporting the projects as well as to individuals claiming damages. Besides considerations of weighing litigation costs against costs of settlement outside of condemnation proceedings, these administrators must further recognize that local support of water control projects is influenced by the manner in which damage claims are settled.

Although standardized procedures for evaluating damage claims have been developed, unique problems arise that necessitate either modification of these existing approaches or the development of new techniques. To insure complete justice for all parties concerned, the applicability of any method of measuring damages and determining rates of compensation must be examined with care. The purpose of this paper is to describe one such unique situation and outline three alternative procedures that might be used to determine the amount of compensation due land owners for damages incurred.

† This paper is based on a report prepared by the authors at the request of the Central and Southern Florida Flood Control District, West Palm Beach, Florida.

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Description of the Islands and Land Use

Ritta, Kraemer and Torry Islands are situated near the southeastern shore of Lake Okeechobee (see Map I). In the absence of existing farm dykes these islands comprise 4,150 acres at a lake elevation of 12 feet mean sea level and 440 acres at elevation 16 feet mean sea level.[1] With existing farm water control facilities approximately 2,800 acres can normally be used for farming operations. The entire acreage is inundated at lake elevation 18.5 feet mean sea level.[2] The predominant soils of these islands are the highly productive Okeechobee mucks.[3]

Due to the tempering effects of the lake these islands enjoy a climate which is almost frost free, while on the mainland a few miles away frost occurs more frequently during the winter and early spring. Most, if not all, of the value of the islands above and beyond mainland land is due to climate.

While it is theoretically possible to produce three crops of vegetables a year (fall, winter, and spring) in this area, mainland farmers are restricted to a fall and spring crop by the frost hazard in mid-winter. On the other hand, island farmers are generally limited to winter and spring crops because of high lake levels which follow the seasonal pattern of rain in the late summer and early fall.

[1] U. S. Congress, *Comprehensive Report on Central and Southern Florida for Flood Control and Other Purposes.* House Document 643, 80th Congress, 2nd. Session (Washington: United States Government Printing Office, 1949), p. 41.

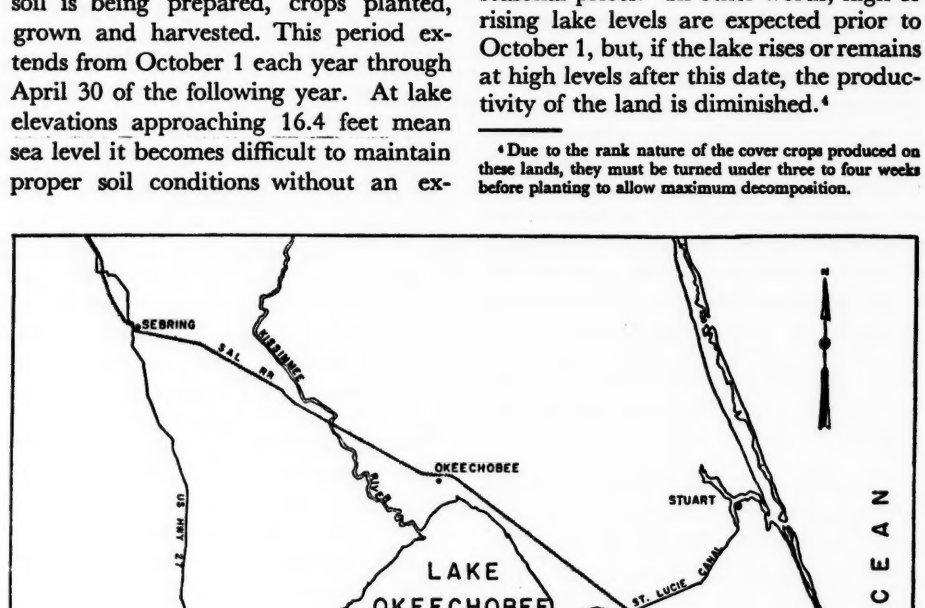
[2] *Ibid.*

[3] L. A. Jones, et al., *Soils, Geology and Water Control in the Everglades Region,* Florida Agricultural Experiment Stations Bulletin 442 (1948).

The profitability of producing winter vegetables on the islands depends in part on the ability of farmers to maintain the water table at levels which facilitate efficient production of crops. Control of the water table on the islands depends in turn on the elevation of the lake when the soil is being prepared, crops planted, grown and harvested. This period extends from October 1 each year through April 30 of the following year. At lake elevations approaching 16.4 feet mean sea level it becomes difficult to maintain proper soil conditions without an extensive system of dykes, ditches and pumping facilities.

When the level of the lake begins to fall consistently, island farmers begin to prepare the land for planting. If they are able to plant by November 1, they are reasonably assured of receiving the peak seasonal prices. In other words, high or rising lake levels are expected prior to October 1, but, if the lake rises or remains at high levels after this date, the productivity of the land is diminished.[4]

[4] Due to the rank nature of the cover crops produced on these lands, they must be turned under three to four weeks before planting to allow maximum decomposition.



Historical Background and the Conflict of Interests

During the first quarter of the 20th century the completion of several drainage projects in the Everglades coupled with several years of relatively low rainfall substantially lowered the elevation of the lake. In this period the elevation of lake Okeechobee was determined by (a) the rate and frequency of rainfall in the watersheds to the north, (b) the rate of evaporation (which is closely related to the temperature), and (c) the rate at which water was discharged to the sea through canals and rivers.

Because lowering of the level of Lake Okeechobee to approximately 12 to 14 feet mean sea level enhanced the usefulness of the islands for agricultural purposes, farmers began homesteading land on these islands in 1917.

Immediately after the severe hurricanes of 1926 and 1928, the primary objective of controlling water in the Everglades was changed from drainage to flood control. Among other things the new flood control program called for: (a) increasing the water storage capacity of Lake Okeechobee, (b) enlarging the canals through which water could be discharged to the sea, and (c) regulating the level of water in the lake over a wider range of elevations. To achieve these objectives the federal government, acting through the Corps of Engineers, cooperated with state and local agencies in the construction of new canals and locks and a new levee around the southern shore of the lake. As these facilities approached completion it became possible to maintain the lake at higher elevations.

In 1937 and 1938 some of the owners of land on Ritta, Kraemer, and Torry Islands contended that their crops were damaged as a result of maintaining the lake at elevations exceeding 17 feet. However, the Court of Claims denied the land owners claim for damages and in doing so found that the alleged crop losses were due to wind, tide and causes other than the level at which the water was impounded.[5] Although the land owners were unable to collect damages, the incident clearly demonstrated the conflict of interests arising from the regulation of the lake level.

The coincidence of a drought in 1945 and a severe hurricane and abnormally heavy rainfall in 1947 made it apparent that a water control program primarily designed to drain land and control floods would not facilitate the attainment of the maximum economic potential of the area. From the lessons learned during this and previous periods of floods and droughts, a comprehensive plan for controlling water in the area was developed by the United States Army Corps of Engineers. In preparing this plan, it was recognized that the basic problem was "to restore the natural balance between soil and water in this area insofar as possible by establishing protective works, controls and procedures for the conservation and use of water in this area."[6] To do this, it was necessary to define a geographic area that included the entire Kissimmee River watershed as well as an overflow area below the lake.

When all of the structures called for in the Comprehensive Plan are completed, it will be possible to control the flow of water into, as well as out of Lake Okeechobee and hence its level.[7] To conserve water and make it more useful, it will be necessary to maintain lake elevations as high as 16.4 feet more frequently and for longer periods than in the past. However, possible damage to island owners must be balanced against benefits that will accrue to the entire

[5] *Creech, et al.*, vs. *U.S.*, 103 C.Cl.801.
[6] U. S. Congress, *op. cit.*, p. 33.
[7] *Ibid.*

area. If the islands are totally destroyed, the loss—measured in the value of the island land—could be conservatively estimated at approximately $1,120,000.[8] On the other hand, annual benefits from the project to the Everglades and lower east coast regions alone are estimated to be over $20,000,000.[9]

Alternative Methods of Compensating Land Owners

The island land owners might be compensated for damages incurred from regulating the lake at higher levels by one of the following methods: (1) acquisition of fee title ownership of island lands, (2) acquisition of flowage easements, and (3) compensation of island farmers on an annual damage basis.[10]

Acquisition of Fee Simple Title. Just compensation for depriving land owners of the use of land permanently has been defined by the courts as the fair market value and they have further emphasized the willing buyer-willing seller concept.[11] However, fair market values of Ritta, Kraemer and Torry land are difficult to establish because: (1) island land has not been traded frequently enough to establish a reliable price, (2) the possibility of lake regulation at higher than usual levels has been known since 1949 and thus recent transactions tend to be based on the evaluation of the productivity of land after the lake is regulated rather than before, and (3) the lack of farm cost and return records from which capitalized net return estimates of land values could be determined.

Except for climatic environment, the lands that comprise the islands and mainland are similar in most respects. Inasmuch as practically all of the value of the island land lies in its ability to produce agricultural products, the value of climatic dissimilarities can be measured in terms of differences in their value productivity when used to produce a common crop. To the extent that the per acre costs of production of specific crops grown on the two types of land are approximately the same, differences in gross receipts constitute an estimate of the difference of value productivity. This difference, when capitalized, provides an estimate of the difference in value of the two types of land, which once determined, can be added to the market value of mainland land as established by accepted appraisal techniques.

Over a ten-year period, gross income from a winter and spring crop of snap beans averaged $13 more per acre per year than the gross income from a fall and spring crop (see Table I). On the basis of a six percent in perpetuity capitalization, land capable of producing a winter and spring crop of snap beans

TABLE I—AVERAGE YIELDS, PRICES AND GROSS RECEIPTS PER ACRE OF SNAP BEANS BY SEASON IN THE EVERGLADES REGION OF FLORIDA*

(for crop season years 1945-46 through 1954-55)

Season	Simple Average Yield Bushels per Acre	Simple Average Prices Dollars per Bushel	Weighted Average Gross Receipts Dollars per Acre
Fall.....	90	$2.76	$242.00
Winter..	90	2.80	255.00
Spring..	103	2.48	258.00

* *Source:* Computed from data presented in *Florida Vegetable Crops, Annual Statistical Summaries*, Florida Crop and Livestock Reporting Service, Orlando, Florida.

[8] This estimate was obtained by multiplying 2,800 acres by an average value of $400 per acre. This per acre value does not indicate the differential between the islands and mainland in that lands on the mainland without the climatic advantages of island land are frequently traded at prices at or above this figure. (See R. L. Lassiter, Jr., "An Analysis of the Movements in Agricultural Land Prices and Values in Palm Beach County, Florida, 1940-1955," unpublished Ph.D. dissertation, University of Florida, January 1957.)

[9] U. S. Congress, *op. cit.*, p. 51.

[10] A fourth alternative of public payment for construction of higher dykes around the islands is not evaluated here because of the lack of cost data.

[11] Kris Kristjanson, *TVA Land Acquisition Experience*, South Dakota Agricultural Experiment Station Bulletin No. 432 (August 1953), p. 7.

would be worth approximately $225 per acre more than land which can produce only a fall and spring crop.[12] However, in perpetuity methods of valuation are not strictly applicable to the situation at hand. Organic soils are subject to subsidence (caused primarily by oxidation) and the remaining economic life of these soils has been estimated to extend to the year 2,000.[13] The present worth of $13 income per year for 43 years would indicate a difference in per acre value of approximately $199. These estimates are remarkably close to those based on limited observations of differences in commercial rents which, capitalized at the same rate, suggest that island land is worth $203 more per acre with a perpetuity capitalization and $190 more per acre using the estimated life of the soil.[14]

Acquisition of a Flowage Easement. Land owners may also be compensated for damages by the purchase of a flowage easement. The amount of compensation will be determined by (1) the period and length of time during which the easement may be used and (2) the damages inflicted when the easement right is used. Thus, if and when an approximate schedule of the level at which the lake will be maintained at specified times is established, the value of a flowage easement can be estimated.

Most of the loss of income suffered by island owners has its origin in the effect of rising or high lake elevations during the first part of the growing season. This, of course, is due to the seasonal pattern of fresh vegetable prices (see Figure I). High lake elevations during the summer months have little effect on the land's productivity provided the level of the lake is falling by the time farmers should

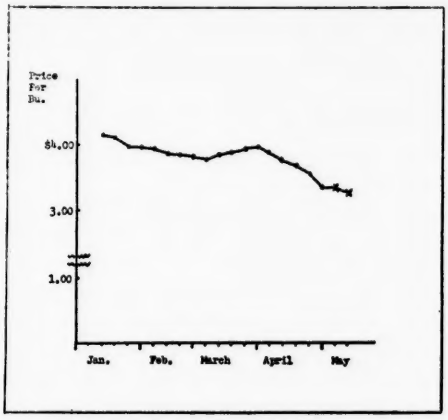


FIGURE 1—WEEKLY PRICE MOVEMENTS OF SNAP BEANS IN EVERGLADES REGION OF FLORIDA. (Five-week moving average of ten-year weekly average f.o.b. shipping point prices. *Source:* Computed from data presented in *Southern Florida Vegetable Marketing Season*, Federal-State Market News Service, Belle Glade, Florida.

be preparing the land for the winter crop, and further does not appreciably exceed an elevation of 15 feet mean sea level. Normally, to receive the peak prices for fresh vegetables, land preparation should begin by October 1, and planting must begin by November 1. Delays in planting the winter crop also delay the spring crop and further losses result as vegetable prices seasonally decline. Therefore, for the right to delay planting the public should compensate island farmers for the total reduction in gross receipts.

In the general case, the value of a flowage easement can be expressed:[15]

[12] The six percent capitalization figure is standard with the Florida Agricultural Experiment Stations. See D. L. Brooke, *Costs and Returns from Vegetable Crops in Florida*, Florida Agricultural Experiment Stations (1955), Vol. X.

[13] J. C. Stephens and L. Johnson, *Subsidence of Peat Soils in The Everglades Region of Florida*, United States Department of Agriculture, Soil Conservation Service in cooperation with the Central and Southern Florida Flood Control District and the Florida Agricultural Experiment Stations (August 1951), p. 14.

[14] See *Appraisal Report* submitted by Island Land Owners (in the files of the Central and Southern Florida Flood Control District, West Palm Beach, Florida). The average rents of island land and mainland land were $39.10 and $26.93 per acre, respectively.

[15] Use of the average delay in planting is not entirely proper in that a probability distribution of lake levels does not specify the years in which the delays will occur. For the formula to exactly value a flowage easement the dates and lengths of delays must be specified. However, due to the vagaries of weather, such information cannot be predicted and the average annual delay offers the most practical solution.

$$V = \frac{d(O_1 \Delta P + O_2 \Delta P)}{I}$$

Where: V = the value of the flowage easement.
d = the average number of weeks that planting is delayed each year.
O_1 = the average winter yield.
O_2 = the average spring yield.
ΔP = the average reduction in price per week.
I = the interest rate

In contrast to the perpetuity method above, the value of a flowage easement allowing for subsidence would be:

$$V = \frac{d(O_1 \Delta P + O_2 \Delta P)}{I} \left[1 - \frac{1}{(1 + I)^n} \right]$$

Where: V, d, O_1, O_2, ΔP and I are defined as above.
n = the expected economic life of the organic soils.

For example, the average weekly decline in snap bean prices is approximately \$0.04 (Figure I).[16] The approximate average yield per acre of snap beans is 90 bushels in the winter and 100 bushels in the spring (Table I). An average delay of one week in planting would indicate a value of a flowage easement of \$118 per acre, i.e. the reduction of a gross revenue of \$7.60 capitalized for the economic life of the soils. Since elimination of the spring crop is unlikely, the practical limit to which the value of island land could be reduced would be approximately one-half the value of mainland land.

Compensation for Annual Damages. Annual compensation for damages incurred may present a desirable alternative. In the particular problem at hand, a contract should specify: (1) a date and lake stage at which damages begin, (2) a formula for computing damages, and (3) the time period covered by the contract and a method of arbitrating differences.

The normal planting date has already been specified (November 1) in the discussion of flowage easements. One method of calculating damages would be:

$$D = P_w O_1 + P_s O_2$$

Where: D = value of damage.
P_w = the winter price foregone due to delayed planting minus the winter price received.[17]
P_s = the spring price foregone due to delayed planting minus the spring price received.
O_1 = the average winter yield.
O_2 = the average spring yield.

It is obvious from the formula above that price variations may cause the damage payment to be zero or have a negative value.[18] In that case no damages would be due island farmers.

Conclusions

The desirability of using any one of the described methods of compensating the owners of island land for damages due to raising the level of Lake Okeechobee depends upon the frequency and extent to which the land will be flooded more than in the past. If the lake is to be held continually at levels that delay farming operations through November, the acquisition of the fee title would probably be the most satisfactory way of paying the land owners for damages. However, if the lake will be held at levels that will delay planting less frequently and if it is possible to make a probability statement about the frequency that this will happen, a flowage easement would cost the public less and at the same time allow the owners to continue to farm the island land. It must be recognized, however, that purchase of a flowage easement does not remove the possibility of political pressures to alter the lake regulation schedule. Finally, if controlling the level of the lake inflicted damages on the island land

[16] A linear decline in prices is adequate because of price variability within and between season and the nature of the price and yield data.

[17] Under unusual conditions the supplies of fresh vegetables produced on the islands may have a material influence on price. If, for example, winter crops on the lower east coast of Florida are extensively damaged; the apparent price foregone by island producers may differ appreciably from the actual price they would have received if they had not been delayed (assuming that demand is highly inelastic at higher prices). However, in the absence of demand elasticity data and data pertaining to the frequency of extensive crop damage on the lower east coast, this factor can not be evaluated.

[18] Rather than relate damages to some prior time period, Federal-State Market News Service price data are adequate to provide current price relationships.

only occasionally, it might be more practical to make a settlement for each delay in planting.

Policies for public regulation of water levels are generally spelled out in sufficient detail to provide the basis for adequate evaluation of the damages they may cause. However, due perhaps to the uncertainty of future state and federal appropriations, no detailed schedule for controlling the level of Lake Okeechobee has been adopted by the agencies responsible for carrying out the Comprehensive Plan of the Central and Southern Florida Flood Control Project. In the absence of such a schedule this paper could only suggest the tools for determining alternative compensation means and rates. Administrators of public projects must take cognizance of the fact, however, that the lack of definite planning may create uncertainty which may in itself lead to damages to private individuals.

Migration from a Southern Appalachian Community

By B. H. LUEBKE* and JOHN FRASER HART**

THE UPLANDS of the Appalachian South have niggardly land but fertile people. Although some parts of the Southern Appalachian area have adequate natural resources and economic organization to support their present population and even to attract new people, by far the greatest part of the region has a population in excess of its opportunities and resources. In 1930 Marschner could show that "in parts of the more-or-less secluded hill and mountain recesses in the Southern Appalachians, untouched by the arteries of travel and communication, a relatively dense population has backed up on the land in unfavorable natural surroundings . . . . Accustomed to a comparatively low standard of living, with little or no means or opportunity for education and training, many of the youth of these areas are handicapped."[1]

In recent years, however, the paved highway, the automobile, and the radio have opened up one mountain fastness after another. The people of the hills are demanding a better standard of living but the adjustment of the local economy to that of the nation requires response to the national labor market by migration. Although out-migration has long been one of the more striking demographic characteristics of the Southern hill-lands, the trickle of migrants has swollen to a flood within the last two decades. Unfortunately, the long isolation of the mountain people has erected cultural barriers which make it difficult for them to adjust to a different, urban mode of life. Many problems arise as the migrant moves "from the local-personal-informal relations of an understandable world of small groups toward the more strenuous world-wide, centralized, formal, segmental relations of the 20th Century."[2]

What are the mechanics of migration from the hills? What problems do migrants face? How well do they adjust to their new environments? The answers to these questions were sought by intensive investigation of the Chestnut Hill community, an area small enough to permit intimate observation of actual and potential migrants. Data on occupational and residential changes and adjustments were obtained from 177 present or former residents of Chestnut Hill with migration experience. Personal interviews were held in the area itself, in Knoxville, and in Detroit; satisfactory information commonly could be obtained from friends or relatives still in the area when personal contact proved impractical. Familiarity thus obtained with the home, community, and occupational environment of migrants, both at the source and at the destination, permitted insight into the decision-making process in migration and into the subsequent adjustments necessitated by migration.

The Chestnut Hill area lies at the eastern edge of the Great Valley of East Tennessee in the most remote and isolated part of Jefferson County (Map). The area includes a western belt of rich bottomland along the French Broad River, a central belt of infertile shale hills, and the rocky slopes of a Blue Ridge Mountain outlier in the east. The

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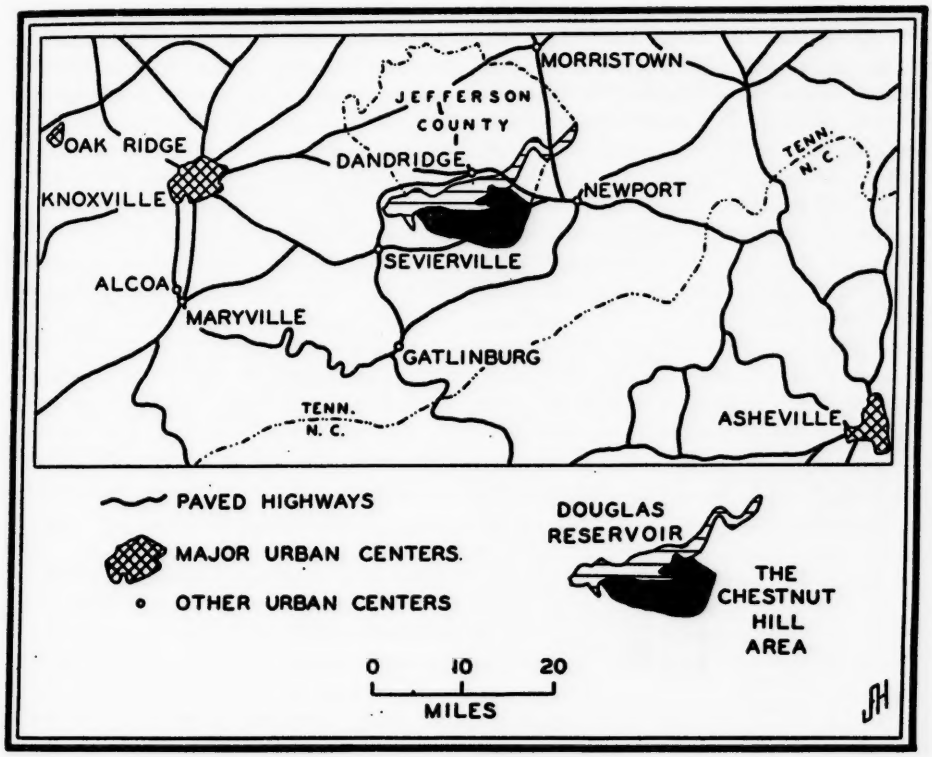
[1] Francis J. Marschner, *Rural Population Density in the Southern Appalachians*, United States Department of Agriculture Miscellaneous Publication Number 367, Washington: Government Printing Office, 1940, p. 4.

[2] Robin M. Williams and Howard W. Beers, *Attitudes Toward Rural Migration and Family Life in Johnson and Robertson Counties, Kentucky, 1941*, Kentucky Agricultural Experiment Station Bulletin 452, Lexington, 1943, p. 36.



emergency construction of Douglas Dam in 1943 flooded most of the fertile bottomland in the area and necessitated considerable adjustment of population.[3] Douglas Reservoir now separates Chestnut Hill from the county seat (Dandridge) and from the easiest route to the closest large city (Knoxville).

Before 1870 there was little areal differentiation in the self-sufficient regional economy of East Tennessee. In the early years of settlement the problem of surplus population was readily solved by clearing new land for agriculture and by making more intensive use of land already cleared. Areal differentiation in the economy began to develop with the occupance of all available land and the steady growth of Knoxville. The vicinity of urban areas continued to develop after 1870, whereas economic and cultural lag was increasingly pronounced in more remote parts of the region, such as Chestnut Hill.

The period 1870-1900 around Chestnut Hill was a time of migration to the agricultural West although development of lumbering and the tanbark industry provided some local nonagricultural employment. Declining availability of land in the West coincided with the passage in 1903 of a Tennessee fence law

[3] The senior author's investigation of local readjustments associated with reservoir flooding provided invaluable contacts in the Chestnut Hill area which facilitated collection of personal and confidential information from local residents. One cannot overemphasize the value of such contacts in investigating a culture group characterized by deep distrust of inquisitive strangers. B. H. Luebke, "Problems Created by the Douglas Reservoir in East Tennessee," *Journal of the Tennessee Academy of Science*, 29, 1954, pp. 246-259.

which effectively sounded the knell of the old subsistence economy.[4] Farmers were no longer able to "free range" flocks of sheep to provide home-spun woolen clothing and there was a steady shift to the purchase of clothing, a cash economy, and commercial agriculture. This same period witnessed the first small trickle of migration toward Knoxville although for many years this movement was retarded by cultural lag, especially in education.[5] Those lucky children whose parents could afford to send them to boarding schools outside the community were among the first to leave Chestnut Hill for urban employment.

The closing of opportunities for western migration coincided with aggressive recruiting by Carolina textile mill representatives between 1900 and the first World War. At one time twenty families from the area moved to a single mill village. Additional, albeit seasonal, employment opportunities were provided in the local community by two canning factories which opened just before the first World War. Income earned at these factories served to hold many marginal farm residents in the area; the factories also provided a market for truck crops grown on the bottomlands.

The second World War opened new opportunities to the people of Chestnut Hill. Workers could commute to the expanded aluminum factory at Alcoa, to the nuclear research plant at Oak Ridge, or to other defense industries in the Knoxville area (Fig. 1). Many local people obtained employment in the construction of Douglas Dam, although subsequent reservoir flooding forced 180 families to leave the area. Unfortunately, however, many of the poorer families elected to remain despite social disruption, community disorganization, and the serious handicap of lost bottomland.[6]

In the middle 1920s there was a brief flurry of migration from Chestnut Hill to northern industrial centers, but many migrants returned during the troubled Thirties. Movement to the industrial North was not resumed until after the second World War and as late as 1952 had not assumed major proportions. Nevertheless, Chestnut Hill has been losing population steadily for the last fifty years, with the exception of returnees during the Depression Decade. The rate of population loss for the half century averages 8.8 persons per thousand per year; by 1950 the population of Chestnut Hill was little more than half what it had been in 1900.

Current migration from Chestnut Hill was estimated by determining the present location of all pupils registered in local elementary schools in grades 4 to 8 between 1943 and 1945. This list of 156 pupils includes all those of employable age in 1952, but excludes any whose families might have been relocated during reservoir construction in 1942. Fifty-seven (36.5 percent) of these 156 have remained at home, although ten (6.5 percent) commute to near-by towns or to Knoxville (Table I). Forty-nine (31.5 percent) have moved to near-by towns, thirty-five (22.5 percent) are in school or in service, and eight (5.1 percent) have gone north, although half of them had returned and one has been drafted. Seven could not be located. In short, one of every five pupils of the 1943-45 period was still in school or in service, two had moved away, and two had remained in the community.

[4] *Cf.* Eugene Cotton Mather and John Fraser Hart, "Fences and Farms," *Geographical Review*, April 1954, p. 207.

[5] The earliest communication with Knoxville was by river boats which carried corn whiskey as a staple item. Although there was no evidence of moonshining in the Chestnut Hill area in 1952, Durand reports that the people of neighboring Cocke County are not so lawabiding. Loyal Durand, Jr., " 'Mountain Moonshining' in East Tennessee," *Geographical Review*, April 1956, p. 173.

[6] Luebke, *op. cit.*, p. 257.

TABLE I—Location and Occupation in 1952 of Pupils Registered in the Fourth Through Eighth Grades in Chestnut Hill Schools in the Years 1943-45*

Location and Occupation	Total	Male	Female
At home	57	26	31
farming	7	7	0
farming and/or part-time work	6	3	3
commuting	14	5	9
no regular work	30	11	19
Moved away	49	17	32
nearby areas	18	5	13
Tennessee cities	21	8	13
Carolina towns and cities	10	4	6
In school	18	8	10
In service (or with service spouse)	17	15	2
Went North	8	6	2
remained	3	3	0
returned to Chestnut Hill	4	2	2
drafted	1	1	0
Unlocatable[1]	7	4	3
Total	156	76	80

* Includes children born from 1927 to 1934, with modal year of birth 1931.

[1] Children of transient tenant or non-farm families.

At first glance a migration rate of forty percent in ten years appears rather high. When Chestnut Hill is compared with relatively similar areas in the Eastern Highland Rim,[7] however, it would seem that recent migration from Chestnut Hill is more retarded than in other parts of the Southern Appalachians (Table II). Seven of every ten Highland Rim pupils have already left the home community, in contrast to only two of every five in Chestnut Hill. Chestnut Hill has the double advantage of the local canning factory and location next Knoxville, but both are illusory. The canning factory employs only five percent of the group studied and the work is definitely part-time; commuting from Chestnut Hill is proportionately less than from the Eastern Highland Rim. In short, the Chestnut Hill area has a larger number of unemployed young people who are just "hanging around," and the same appears to hold true of older folk as well. What is it that holds these people? Why do they fail to take advantage of greater economic opportunities elsewhere? Why don't they migrate to greener pastures?[8]

[7] Nine school districts in Overton and Putnam Counties.

TABLE II—Location in 1952 of Pupils Registered in the Fourth Through Eighth Grades of Chestnut Hill and Highland Rim* Schools in the Years 1943-45

Location in 1952	Chestnut Hill		Highland Rim*	
	number	*per-centage*	*number*	*per-centage*
Home community	69	44.2	62	20.4
Within 30 miles	26	16.7	64	21.1
30-199 miles	30	19.2	33	10.9
200 miles or more	8	5.1	113	37.3
In school, in service, or dead	23	14.8	32	10.6
Total	156		304	

* Areas in Overton and Putnam Counties.

Land ownership appears to be a powerful force working against migration.[9] More than two-thirds of the Chestnut Hill families contributing migrants to the North in the last generation were tenant families although less than one of every ten farmers in the community is a tenant. Small farms contribute to residential stability by providing a home and subsistence, although commonly both are substandard. Flush toilets are a rarity in Chestnut Hill and some parts of the community lack telephones and electric power. Most of the land is too steep or stony for cultivation.

[8] This metaphor is strikingly inappropriate, as economic advantage for these people is to be found primarily in urban areas yet the authors are unable to discover a term applicable to urban areas which compares with "greener pastures."

[9] For a similar conclusion drawn from a study of migration in another part of the Southern Appalachian hills, see Howard W. Beers, *Mobility of Rural Population, A Study of Changes in Residence and Occupation in Two Types of Rural Communities*, Kentucky Agricultural Experiment Station Bulletin Number 505, Lexington, 1947, p. 37.

The value of land and buildings on the average farm in 1950 was $2,962, less than a quarter of the national average.

Numerous factors apparently serve to keep Chestnut Hill people on their farms. Some people like to farm; others know no other life. The prestige value of land ownership is high in the area and some tenants have been able to improve their social status by acquiring remnant farms sold by wealthier farmers who left the area when their bottomland was flooded.[10] Various types of state and federal aid have tended to stultify agricultural practices and to tie the marginal farmer to the area, especially if he is a marginal unskilled worker.[11]

The deep conservatism which leads mountain people to choose to remain in an area which many of them freely admit is economically, socially, and culturally retarded may be described as part of the Mountain Yeoman Complex of the Southern Appalachians.[12] This complex is compounded of a surprising contempt for material things, strong family and community ties, and deep Fundamentalist religious beliefs. Little value is placed on formal education which might well have broken down some cultural barriers. Although the Mountain Yeoman culture is now rapidly disappearing, it still has considerable strength in many remote parts of the Southern Appalachians such as Chestnut Hill.

Although the people of Chestnut Hill are frugal and independent, they are not dominated by materialism. They react slowly to any promise of high wages in a distant city. One local woman who had worked in Knoxville remarked that they "will not exchange local work at low wages for a pot of gold somewhere else." They still attach considerable importance to the pioneer virtue of living within one's income. Farmers neither know nor desire the Cotton Belt credit system, nor are they willing to accept tenancy or mobility as a way of life.[13] The Southern Appalachian farmer has something of the peasant's love of his land. Moreover, he keenly appreciates the natural amenities and would not willingly exchange his farming, hunting, fishing, and loafing for the factory, the ball park, the race track, and the sports arena. One local resident, a qualified surveyor who checks PMA allotments, returned from South Carolina in 1940 and bought 38 acres of rocky wooded mountain land for ten dollars an acre. Tobacco is his sole cash crop. He tends a cow, a pig, and a garden near his log cabin, which is a mile and a half from the road and power line. He frequently seeks quiet and satisfaction by going still farther out into the wilderness to hunt, or merely to sleep out overnight without blankets or tent.

Strong family and community ties are yet another aspect of the Mountain Yeoman Complex which tend to restrict migration from the Chestnut Hill area. The birth rate is high[14] and large families discourage residential mobility. Long distance moves from Chestnut Hill are virtually always made by single persons or childless couples although a few one-child families have left the child with relatives, especially if it is of school age.

[10] For a brief note on the prestige value of land ownership in the South as a whole, see Fraser Hart and Eugene Mather, "Southern Agriculture, Thirty Years of Progress in the Last Half Century," *Annals of the Association of American Geographers*, June 1954, p. 211.

[11] For further development of this theme, see "Unmixing Farming," Dixie Today Supplement, *The Economist*, September 1955, pp. 5-6.

[12] For another discussion of the mountain culture of the Southern Appalachians, see Rupert B. Vance, *Human Geography of the South*, Chapel Hill: University of North Carolina Press, 1932, pp. 247-251. For a fictional account of mountain life, see Harriette Louisa Simpson Arnow, *Hunter's Horn* (New York: The Macmillan Company, 1949).

[13] The various credit systems of the Cotton Belt, as well as recent population changes, are described in Merle Prunty, Jr., "The Renaissance of the Southern Plantation," *Geographical Review*, October 1955, pp. 467-488.

[14] The married women in the community commonly have more children than their sisters of similar age who have moved outside.

In addition to the problems and expenses of moving with children, there is the difficulty of finding adequate accommodations in the city where apartment house managements discriminate against children.

It appears that the wife's attitude toward migration is crucial. Her home and community ties tend to be stronger and she frequently is unhappy far from home although she offers little resistance to short moves. Death or divorce of parents, on the other hand, tends to favor migration. In one family the three children of the first wife left the community many years ago and seldom return, whereas none of the four grown sons of the second wife have ever left home; one has driven his two-year-old car less than twenty-five miles a week.

The stage of community depopulation is an important factor in migration. After a certain proportion of the people have moved and community institutions begin to languish, it becomes increasingly easier for the remainder of the population to break away. It should be noted, however, that community transplantation has actually taken place in some areas and it would appear that such transplantations offer the greatest hope of stability in migration.[15] Such was the case in early migration to textile mill towns in the Carolinas. Although northward migration from Chestnut Hill has not yet passed the single individual or childless couple stage, it is worth noting that four families moved 400 miles northeast to buy and operate farms near Farmville, Virginia, about the time of reservoir flooding.

The church is the principal community institution in the Southern Appalachians and it commands very strong year-round allegiance.[16] The religion, whatever the denominational name, is Fundamentalist, requiring an extremely literal interpretation of the Bible and a rigid mode of conduct. Many devout people in Chestnut Hill are genuinely concerned over moral looseness and "paganism" in large cities, especially in the North. Then too, the mountain church tends to emphasize fiery preaching and the greater formality of urban ministers fails to satisfy migrants.

In summary, religious, community, and family ties combine with a strong love of the land, a disdain for material things, and distrust of formal education to keep the people of Chestnut Hill where they are. How does a person in Chestnut Hill finally bring himself to leave? How does he find a job outside the local community? What are the mechanics of migration?

Migration is a strongly selective process. Quite apart from the general considerations of the Mountain Yeoman Complex, which affect all the people of Chestnut Hill in varying degree, there are specific factors which influence the individual decision. Some men lack the physical strength or health required for certain forms of unskilled work.[17] Younger people may be forced to remain at home to care for aged or infirm parents or relatives. The boy who is mentally slower than his brothers often remains to help his father work the farm.

Other considerations induce departure. One farm tenant, whose large family were all girls, decided to move to the Carolina textile mills where there would be a better chance of finding them jobs and marrying them off. A farmer gave

[15] A community which migrated from the Highland Rim has actually established its own church in Detroit and the people appear much better adjusted than single migrants from Chestnut Hill.

[16] The stern, unyielding, year-round puritanism of the Southern Appalachian hills is in striking contrast to the seasonal revivals of emotionalism and "halleluiah-shouting" in the "cotton patch" religion found farther south.

[17] A local boy reluctantly went north in search of work because he lacked the physical strength to join his father in the pot room of the aluminum factory at Alcoa.

away all his cabbage and left for Detroit because he felt the canning factory had treated him unfairly. A family sought to assuage their grief over the death of their son by leaving familiar places. Two couples locked up their new modern homes and sought remunerative industrial employment to help pay the construction bills; a heavy accumulation of medical bills was instrumental in leading another man to seek a better-paying job outside the community.

The decision to leave the community is conditioned in large measure by information on available jobs. Inadequate job information is at least partially responsible for a low migration rate from Chestnut Hill. Considerable job information reaches the community during periods of national labor shortage when Northern concerns are sending out individual recruiters to comb the Southeast for more workers but generally the area has subnormal access to job information. In some measure this is due to low educational levels and failure to read newspaper advertisements although radio broadcasts and public or private employment agencies do not appear much more effective as media of dissemination. Most job information is received as a result of social contacts. It is thus vital to the community to have "representatives" throughout the country in cities where jobs may become open; the job seeker cannot afford to travel to a strange and socially—if not geographically—distant city and maintain himself there while looking for work. If a man cannot be reasonably sure of a job he will not leave home.

The man's attitude toward urban life and industrial routine is also an important factor in his decision to stay or go. He may not be accustomed to such modern routines as punching a time clock, working in a gang, or joining a union. A sudden move from the mountains to an industrial center is difficult at best; it can be greatly facilitated if the individual has had a gradual introduction to new experiences and value systems. The people of Chestnut Hill have been fortunate in learning something of factory life from the local canning factory or from friends or relatives who have worked in Knoxville, the Carolinas, or in the North.[18] Employment in construction of TVA reservoirs was the first nonfarm work for many local people, and was a first step toward fulltime industrial employment outside the area, although some men admit that they were initially hesitant about leaving their "trusted and certain" livelihood from agriculture. In some cases military experiences have emphasized the inadequacies of the old value system and have produced dissatisfaction with the home area or provided mechanical skills and training which have facilitated migration.

Formal education has played an increasingly smaller role as a factor in inducing migration. Interviews with older migrants reveals that education was a selective factor of much greater importance before it was so universally available. Examination of present residence and occupation of the elementary school pupils of 1943-45 reveals no essential difference in rate of migration between those who have graduated from high school and those who have not. Exclusive of agriculture, there is no vocational training for boys in the Chestnut Hill area and many of the jobs attracting men out of the community require only an eighth grade education. On the other hand, it should be noted that secretarial employment in Knoxville has assumed such importance for young girls in

[18] The manager of the canning factory recalls the time when adults could not be depended upon to work steadily; he initiated the practice of hiring young people who could be trained to factory routine.

Chestnut Hill that the local high school has instituted a course of stenographic training.

The case history of two generations of a single family is unusually illustrative. The father moved with his eleven brothers and sisters to a farming area near Dallas in 1901 but eight of them returned to poor hill farms in Tennessee after one year of drought and crop failure. The son completed high school and worked at reservoir construction before entering the Air Force. He was so discontented after his discharge, when he found old landmarks flooded and old friends gone, that in 1947 he went to Cincinnati with no advance job information. After a short period in Cincinnati he moved to Cleveland, and then to Detroit. His wife joined him in Detroit and drew on her county seat hotel experience to open a boarding house which is now Chestnut Hills' headquarters, port of entry, and disseminator of job information for the Detroit area! Eight former Chestnut Hill men now live there and word of job openings is constantly being sent back to Tennessee.[19]

Adjustment problems are of concern to migrants, to the community of origin, and to the community of destination. The migrant's experiences, as reported home, influence the rate of migration by their effect on the decisions of those who remain. The new community finds that large numbers of unassimilated migrants pose serious problems. Comparison of the adjustment problems of Chestnut Hill people in Knoxville, in the Carolinas, and in Detroit indicates the relation of maladjustment in migration to social and geographic distance.

Work in the local canning factory causes little more disruption of the traditional life than work on the farm but daily commuting to the Knoxville area (40-50 miles each way) creates increasing stress and strain. The majority of families finally move to the urban area and discover that the move can be made with a minimum of adjustment. Those who have left Chestnut Hill for the Knoxville area appear happy.[20] Their economic status is improved, they have better housing, the wife has more use of the car, they find congenial neighbors, and church and school adjustments are readily made. There is ample opportunity to hunt, fish, and visit friends in the old community. Although fear of losing a job in Knoxville was at first considered an argument against moving, the majority of migrants report that new jobs are found much more easily by the man who lives in the area. In short, migration from Chestnut Hill to the Knoxville area has proven successful both for individuals and for families because the migrants quickly feel at home among friends.

Although the Carolina textile towns are outside commuting range, the Chestnut Hill family is nonetheless also quickly able to feel at home among friends because the enlightened policies of mill owners have facilitated migration with minimal adjustment. Attempts were initially made to transplant communities with their institutions and to provide good inexpensive housing and facilities for producing subsistence food requirements. In the mill village migrants found congenial neighbors of similar cultural backgrounds and today there is relatively free movement of individuals and families

[19] The importance of advance information on living conditions as well as on jobs is indicated by the experience of one early migrant who arrived in Detroit in March without so much as a topcoat.

[20] For another statement of the adjustment problems of Southern Appalachian migrants in a southern city, see Howard W. Beers, and Catherine Heflin, *Rural People in the City, A Study of the Socio-Economic Status of 297 Families in Lexington, Kentucky*, Kentucky Agricultural Experiment Station Bulletin Number 478, Lexington, 1945, p. 18.

between Chestnut Hill and the Carolina mill towns.[21]

In contrast to movement to Knoxville or the Carolinas, migration from Chestnut Hill to northern industrial centers is virtually always considered a temporary expedient. Detroit, for instance, is a place to make as much money as quickly as possible before returning to a more permanent life at a lower income level. Few migrants from Chestnut Hill even consider making a permanent home there. Movement has been by single people or childless couples, instead of communities, and in Detroit the Tennessee people feel they are among strangers.[22] The prevalence of foreign speech, and a different accent even in English, often makes the man from Chestnut Hill feel that he does not even know what people in Detroit are talking about. Although the majority live in adequate boarding or apartment houses, migrants find the adjustment to urban life difficult. Some object to the lack of segregation. Others are dissatisfied with the churches ("card playing and beer drinking").[23] One man remarked that entering his apartment at night makes him feel like a rat running into his hole. Another asserted his right to personal freedom when told by a policeman to move along, and found himself in the patrol wagon. The majority of migrants work for large corporations and appear better adjusted to the factory than to life outside it. Several have been blacklisted because a spell of homesickness has induced them to return home without leave or advance notice.

On the other hand, some migrants from Chestnut Hill have been quite successful in Detroit and appear well adjusted. After a few years acquiring skill and experience in the shops of a large corporation, the migrant commonly takes employment in a smaller and more specialized shop, or starts his own business. One man who went to Detroit in 1922 has returned to Chestnut Hill and established a business in the home county with his savings; he is frequently called on for advice by young men planning to make the move to the North. Another man worked his way up to foreman with a large company, and then established his own agency to sell industrial insurance to migrants from the South; he has bought an Iowa farm to which he plans to retire. It definitely appears that recent migrants from Chestnut Hill who make an effort to become a permanent part of the Northern industrial center have been more successful than have share croppers from cotton areas in the South.[24]

And what of the future? There is little reason to suppose that migration from Chestnut Hill (or from the Southern Appalachians) will decline within the immediate future. If anything, one would predict an increase. It seems necessary therefore to ask what can be done to smooth the road of the migrant. The readjustment of rural people from local to national labor markets presents challenging problems both from the standpoint of individual welfare and of the welfare of the national economy.

It would appear desirable to introduce vocational training in industrial techniques and processes into rural high schools, especially in those areas where rural population already presses heavily

[21] The textile town most frequently mentioned by Chestnut Hill people is Belmont, near Gastonia, North Carolina, which is about one hundred miles east of Asheville (Fig. 1).

[22] The adjustment problems of migrants in a northern city are described fictionally in Harriette Louisa Simpson Arnow, *The Dollmaker* (New York: The Macmillan Company, 1954).

[23] A Chestnut Hill woman articulated the fears of many local mothers for their migrant children with the statement, "The farther North you go, the wickeder they seem to get."

[24] This thesis is substantiated by Lewis M. Killian, *Southern White Laborers in Chicago's West Side*, doctoral dissertation, University of Chicago, 1949, and by personal communication from Eldon D. Smith, whose field studies of migrant adjustment problems in Indianapolis form the basis for his doctoral dissertation at the University of Chicago.

on available agricultural resources. This training needs to be accompanied by better vocational counselling to give the student some conception of industrial routines and of the vast diversity of employment opportunity in modern industry. The entire program should be followed up by better dissemination of job information in rural communities. The limited funds and personnel of the Federal-State Employment Service largely restrict its activities to larger urban centers. This service needs to be made more accessible to smaller communities, perhaps through use of vocational teachers, part-time or volunteer workers, or even post office bulletin boards.

Areal variations in underemployment have not been given adequate attention. The development of indices of the amount of underemployment in rural areas, and cartographic presentation of these indices, would be a useful guide to the industrialist preparing to recruit workers.[25] The large corporation, especially, if it has its own training program, might well be able to effect migration by community transplantation and thus avoid the wrenches and uncertainties of individual migration. Many mill villages in the Carolinas offer excellent illustrations of the possibility of migration without maladjustment.

Summary and Conclusion

The people of Chestnut Hill are in process of adjusting the local economy to that of the nation, which requires response to the national labor market by migration. As in other isolated portions of the Southern Appalachians, the adjustment is necessitated by population numbers in excess of natural resources and by rates of natural increase which maintain population numbers at high levels. In recent years, and especially since 1940, the mountain people have had ever greater contact with the outside world and they have felt increasing dissatisfaction with their own low living standards. Economic betterment for the great majority of the people of the Southern Appalachians is not to be found in development of the meager resources of the local area but in migration to other areas more richly endowed by nature and by man.

The traditional Mountain Yeoman culture makes it difficult for the migrant to adjust to urban life. He misses the natural amenities and personal freedom of rural life and finds it hard to fit into a regimented society. He adjusts most readily, and is happiest, when he migrates to an area where other migrants with the same cultural background have already congregated; conversely, he faces the greatest problem of adjustment in the North, where he finds relatively few of his own ilk. He commonly remains in the North only to accumulate capital quickly before returning home but his habits of hard work and thriftiness contribute to his success if he decides to remain.

The rural migrant can become an integrated and valuable citizen of his new urban community but he frequently requires assistance. He will be helped to do so if rural schools can introduce him to industrial methods, and if he can obtain adequate information as to available employment opportunities. Study of the distribution of rural underemployment will assist the employer in recruiting new manpower; the new workers will prove more satisfactory if they can be imported in communities rather than as individuals. And the nation as a whole will profit from more efficient allocation and utilization of its manpower.

[25] An example of such an index can be found in Robert E. Galloway, *Rural Manpower in Eastern Kentucky, A Study of Underemployment Among Rural Workers in Economic Area 8*, Kentucky Agricultural Experiment Station Bulletin Number 627, Lexington, 1955, pp. 28-29.

Land Use in the Eastern Extension of the Lake Agassiz Plain†

By DON R. HOY* and ARTHUR H. DOERR**

WHEN, during the last major ice advance in North America, the northern flow of the Red River of the North was temporarily blocked by an ice dam, Lake Agassiz was formed. It covered hundreds of square miles in the western portion of Minnesota, adjacent portions of eastern North Dakota, and northward into Manitoba and, in addition, a shallow arm extended into north central Minnesota and neighboring sections of Canada. This extension covered large portions of present-day north central Minnesota counties principally Beltrami, Lake of the Woods, and Koochiching. When the glacial ice retreated Lake Agassiz was sentenced to death. The drainage of the Red River was reestablished and the lake was slowly drained. Evidence of the existence of the lake is found everywhere. Lake beach lines, glaciofluvial debris, and lacustrine deposits typify the lake plain.

The lake plain is located in both the United States and Canada; however, this paper will be confined to that portion of the plain situated in the United States (Fig. 1). The area is sharply defined on the east and south by morainic uplands, which rise abruptly above the former lake level, on the west by an island of higher elevation locally known as Beltrami Island, and on the north by Rainy River which separates the United States and Canada. The western boundary is less clearly defined, since the lake plain merges gradually with the surrounding countryside. On the other hand, the southern and eastern borders of the region are more readily observable since there is a sharp change in the landscape. On the southern and eastern margin of the plain a rugged morainic upland contrasts with the generally lower level lake plain.

The surface of the lake basin appears to be essentially level, with the glaciolustrine material spread evenly over the lake floor. This is somewhat deceiving, however, for many small depressions exist which are now filled to overflowing with decayed vegetable matter and peat deposits. It is these peaty, boggy areas that restrict human use of the land. Throughout the entire region, encompassing both the peat bogs and the mineral soils areas, the water table is at, or very near, the surface so that an elevation change of only a few feet brings a resultant change in vegetation, soils, and land use possibilities. Only rarely do former beach lines or exposed igneous intrusions break the monotony of the nearly level landscape. The igneous formations and the beach lines both have a general northeast-southwest orientation.

The region has few rivers and streams. The Rainy, Rapid, Bigfork, and Littlefork drain much of the region. Elsewhere drainage is imperfectly developed. Even man has met with failure in attempting to drain the land, though several ambitious projects have been undertaken. Poorly drained swampy conditions prevail over much of the area.

Vegetative and edaphic conditions closely mirror the topography. Tamarack (*larix laricina*), black spruce (*picea mariana*), and several species of sphagnum

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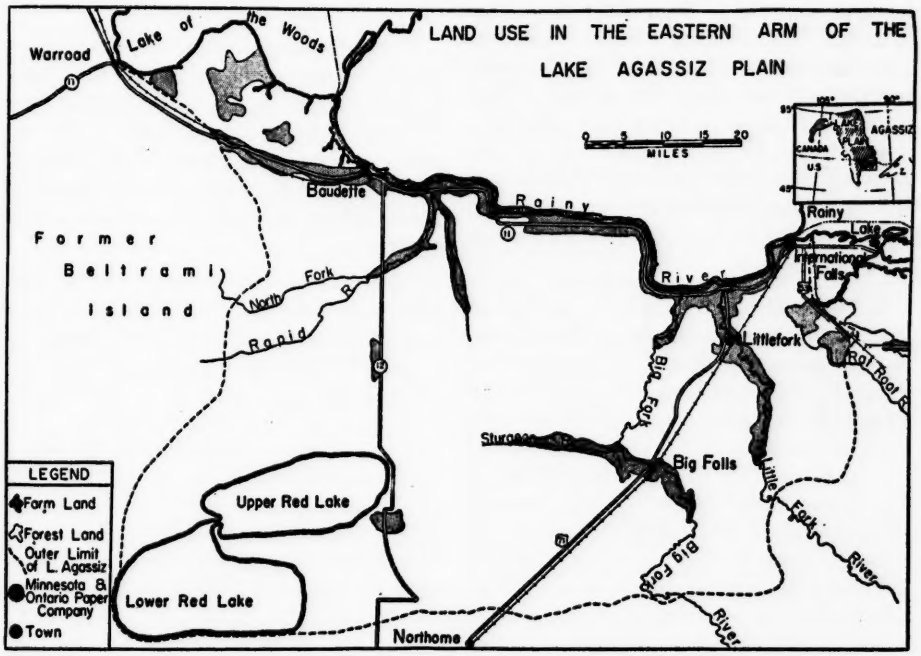

moss are the dominant species located within the poorly drained bog lands. Often these tree species are stunted, with trees 50 to 100 years old being only five or six feet high with diameters of 3 to 4 inches. Such areas are termed locally "Christmas tree bogs." Whenever these species are encountered footing may be extremely dangerous and hordes of mosquitos infest the area.

On the better drained sites, generally near rivers and streams, or associated with local beach lines and igneous sills, several species of pine were originally present. Principal species included white pine (*pinus strobus*), Norway Pine (*pinus resinosa*), and jack pine (*pinus banksiana*). These species have now been largely cut over and aspen (*populus tremuloides*) and various birches have replaced the former stands of pines. Balsam-fir (*abies balsamea*), which is considered by some ecologists to be the climax specie, is generally found as an understory tree.

Most soils have failed to develop a mature profile and much of the land surface is covered with peat deposits underlain by a clay pan. The peat varies from brown, coarse, fibrous material to black, structureless, finely divided matter. It is estimated that about eighty percent of the region has a covering of peat which ranges in depth of up to forty feet, but generally averages about seven feet in thickness.[1] These peat deposits are a serious problem in the area not only because of their negligible productivity but also because they obstruct the construction of roads and railroads.

On the better drained sites soils are composed of a thick layer of organic matter underlain by a zone of lightly

[1] Clayton E. Plumber, "Report of Progress in Peat Development," *Iron Range Resources and Rehabilitation*, Saint Paul, Minnesota, 1949, p. 12.

leached material. Podzolization is the principal soil-forming process but the soils are not true podzols as a mature profile has not been developed. The subsoils are dark in color and generally plastic clay or clay loam. In a few isolated instances scattered throughout the region small areas of light sands are found usually in conjunction with former lake beach lines.

Climatically the region is classed as humid continental with long winters and short, rainy summers. Temperature range from the coldest month's average of 0.8° F. in January to 65.3° F. in July. Extreme minimums and maximums of −49° F. to 103° F. have been recorded but extreme variation of the normal temperature pattern is not frequent although greater oscillations are to be expected during the winter season. The growing season varies from 90 to 110 days, thus limiting crop variety. Often frost remains in the bog areas throughout part of the summer creating a permafrost-like condition.[2]

The mean annual precipitation is about 25 inches of which 75 percent falls during the growing season from late April to early September. Most of this rainfall results from cyclonic action and it is not uncommon to encounter several consecutive cloudy days with light precipitation falling. Approximately 10 percent of the total precipitation comes in the form of snow and since there are few periods of thawing in the winter season the snow frequently attains a depth of 36 to 40 inches.

[2] Personal conference with H. Hays, Engineer for the Rural Electric Administration, Warroad, Minnesota and G. Farrel, Manager (REA), Spooner, Minnesota. If a winter is particularly cold, frost may be found in the bogs during the entire summer, but this is the exception. Generally, however, frost will remain until late in June or early July. For a fuller account see John W. Morris, *Boreal Fringe Areas of Marsh and Swampland: A General Background Study*, University of Oklahoma Research Institute, (mimeographed) January 1954, p. 168.

Drainage Attempts

From the foregoing physical description of the eastern extension of the Lake Agassiz plain it is obvious that the physical environment places rigid restrictions upon man's use of the region. Past attempts to modify the environment have failed or met with only modest success.

Man attempted to drain the swamp and peat land but failed. In the early part of the twentieth century an immense system of drainage ditches was dug with ditches dredged in both a north-south line and an east-west direction. This formed a lattice work of ditches which criss-crossed every two miles. Natural drainage features were little considered, if at all, and this accounts in part for the failure of the project. The major reason that the project failed, however, was the misconception of the water holding capabilities of the peat.

Capillary attraction pulls water up from lower levels through the peat. Thus, because of peculiar water-holding capacities of peat and sphagnum moss, drainage has been unsuccessful even in areas with substantial gradient. In some sections the water table has actually risen after drainage ditches were dug.

In many instances the water table of a swampy or boggy area will be observably higher than a field of non-peat land immediately adjacent to it. These swamps are believed to be self-perpetuating, with man's effort to drain them doomed to failure. During dry periods fire is a hazard. Fires that occur in peat can be extinguished only by a rise in the water table. If, however, the peat is completely burned out the level of the land is reduced to the clay pan surface of the old Lake Agassiz plain. This burned-out area of peat will again fill with water and hydrophytic plants; and the cycle of

peat development will begin all over again.[3]

Though drainage studies are still carried on in the hope that ultimate success will be attained in this large area of northern Minnesota, it probably will be many years before any tangible results are observable. Thus, the immediate problem is how may the peat and swampy land be utilized, rather than how to materially change their structure that presently interests the general public, farmer, economist, and geographer.

Major Economic Activities

The eastern extension of the Lake Agassiz Plain is one of relatively recent pioneering activities. Active settlement of the region began in the decade from 1890 to 1900. Lumbermen came first. Initially, a few large companies passed through the area cutting the larger, more accessible stands of timber and utilizing the rivers for movement of fallen logs to plants bordering and outside the region. Many of the lumber mills were located in Canada around the Lake of the Woods.

The first wave of settlement was followed by the smaller lumber companies and a few settlers who cleaned up the area and penetrated the more inaccessible tracts. A few of these smaller companies are still in existence but the market for their timber is now within the region, generally at International Falls, Minnesota. By and large, both the larger and small companies, during the earlier days, gave no thought to future use of the land and therefore practiced clean cutting, permitted slash fires, and gave no thought to reforestation.

With the passing of the initial phase of lumbering activity the region turned to the development of agricultural pursuits. It was during this time, between 1905 and 1920, that the major drainage efforts were under way. Land companies and ditching contractors painted scenes of flowing wheat fields interspersed with acreages of potatoes and meadow land where at that time stood empty swamps and bogs. An example of the optimism exuded by land companies may be gleaned from the following quotation: "Hundreds of miles of drainage ditches are under construction. One of the largest projects embraces an area equal in size to Rhode Island. The work will be continued until all of these lands are reclaimed and along the side of many of the main ditches will be constructed spendid roads from the dirt excavated in digging the ditches."[4]

The drainage projects failed for reasons previously outlined but the bonded indebtedness lingers on. Homesteads of this peat land were left low and wet instead of the proverbial "high and dry." County governments were faced with the task of furnishing the settlers with roads and other services which would have been extremely costly, or offering them more favorable sites near the developing road net. Few homesteaders refused the county's offer of assistance in moving to other farming localities.

Presently, therefore, the major farming areas of the region are concentrated, with large areas devoid of habitation. Generally these concentrations are situated in close proximity to the major water courses of the region where drainage is sufficient and mineral soils are found. Major localities of farm production are along the entire length of the Rainy River and its major tributaries, namely the Littlefork, Bigfork, and Rapid Rivers. Farm locations along the latter three rivers gradually diminish to the south or upstream as the amount of

[3] *Ibid.*

[4] C. F. Marvin, *Summary of the Climatological Data for the United States*, Section 57, United States Department of Agriculture Weather Bureau, Washington, D. C., p. 1.

prospective farmland decreases. A few other areas are satisfactory for farming but they are not used because of isolation.

Principal agricultural crops, in order of importance, are hay and forage crops, flax, various cereal crops, and potatoes. Hay and forage crops include several varieties of clover, alfalfa, and brome grass. The major cereals produced are oats, barley and wheat. Potato production formerly ranked much higher than it now does but in recent years the total acreage and production has declined. The raising of clover seed has also been important to the region, but yields have steadily declined since about 1940. Clover acreage remains essentially constant but yields per acre are declining. Research into the cause and cure for this declining clover seed production is currently under way.

Much of the crop production of the area is subsidiary to animal husbandry. The eastern extension of the Lake Agassiz Plain is dairy country, and Holsteins and Jersey-Guernseys are almost equally numerous. A few herds of Herefords are scattered throughout the region. Other farm animals are of lesser importance and include sheep, hogs, and the ever-present poultry.

Farmsteads range in size from about 20 acres to more than 600 acres with the average having about 160 acres. Of this total acreage only a small percentage is in cropland with the remainder being in pasture land and in forest cover.

Most farmsteads of the region reflect the emphasis on dairying. The typical layout of one of these farms would consist of a barn of fairly large dimensions including a large hay storage facility, a machine shed much smaller in size, one or more animal shelters which are usually of more recent construction—for dairying is of relative recent emphasis—and a few smaller buildings such as chicken houses, hog sheds, and garages. The more recently erected buildings tend to be of frame and sheet metal construction, while the older buildings are made entirely of wood.

Forestry

Forestry enterprises have again become the primary economic occupation within the region. Through the mutual cooperation of the lumbermen, state, and conservation officers forestry is currently on a sustained yield basis. That is, no more timber is cut and processed than can be grown. In addition, selective cutting is utilized so that trees are marketed when they have attained their most productive growth. By this means forestry industries can attain a permanence that was not possible under the old methods of clean cutting.

Thanks to new research discoveries some species that were at one time considered useless as commercial timber are now being economically cut. Trees such as aspen, tamarack, birch, and cedar, once of no use to the lumberman are now utilized in the making of kraft paper and various forms of insulation board. In addition, tamarack is used as mine timbers.

Aspen is a relatively quick growing tree and the yield per acre over a period of time is substantially greater than that of other commercial trees. For example, an aspen is fully developed for processing when about 35 years old; whereas other trees are not ready for cutting until they are much older. Some species must grow for as long as 120 years before being classed as fully developed commercial timber. The average maturity age for commercial lumber in this region is 65 years.

Most timber cutting is carried on during the winter season. There are numerous reasons for this, but probably the

most important is the difficulty of entering the swampy areas during the summer. Insect pests further deter summer operations. Another factor favoring winter logging operations is that many of the loggers also own or work on a farm during the growing season. To provide for a constant flow of timber to the processing plant it is necessary to maintain a large stock pile to carry through the summer months.

Dominating the forestry industry of this region is the Minnesota and Ontario Paper Company located at International Falls, Minnesota. Though situated at the extreme eastern tip of the Lake Agassiz Plain this company gathers its timber supplies principally from the region. Before the late 1930's the method of transporting the timber to the plant was largely by floating or pulling the logs on the water courses. Since that time, however, practically all transportation of the timber is by truck and rail. Timber cut within a fifty-mile radius of the plant is usually hauled by truck. Logs cut at distances in excess of fifty miles are moved by railroads if possible. Where no railroads exist, trucks are utilized.

The plant at International Falls is a multi-product manufacturing concern with all types of paper and allied by-products being manufactured. Approximately three million trees are consumed by the plant each year. Of this number 45 percent are spruce and balsam, 35 percent are aspen, and 20 percent are jack pine and other related trees. Other raw materials used include coal, sulphur, preservatives and asphalt. These are secured from sources outside the region. Power utilized by the plant is obtained largely from the sources developed at the company-owned dam which has been built across the Rainy River.

Three basic processes are used in the making of the paper. These are the ground-wood method, the sulphite method, and the kraft pulping method. For a time brown kraft paper bags were made at the plant, but competition from southern companies forced the Minnesota and Ontario Paper Company to abandon this phase of its operations. Markets for the products produced at the plant are in general confined to Minnesota, Wisconsin, Illinois, Ohio, and Indiana. The insulation board made at the factory has a somewhat wider market and is sold throughout the United States and Canada and in some South American and European counties.

Minor Economic Activities

Other forms of economic endeavour are relatively insignificant compared to agriculture and forestry. To be sure several small villages are present but these serve only the local inhabitants and cannot be considered basic. Future possibilities for iron ore mining are present for many of the igneous formations found within the region contain some ore. Whether ore is present in commercial quantities is problematical.

Though surrounded by the northern Minnesota fishing and hunting area of national fame, little revenue is realized from the tourists since most of them are concentrated along the fringes of the area where the larger and deeper glacial scour lakes are present. Locally, small creameries supply the economic livelihood of the villages. These are for the most part cooperatives and can barely meet expenses much less operate profitably. Distance from markets seriously hinders dairy production.

Conclusions

Though greatly hampered by the physical features of the eastern extension of the Lake Agassiz Plain man has been able to turn this area of relatively recent occupation to a forestry production and

manufacturing center with agriculture occupying a close second place in the economic livelihood of the region. Forest resources are used largely in the manufacture of paper and allied products and the forest and related products industry is the greatest source of income within the region. Agriculture, though perhaps not so basic an activity, successfully competes with forestry on the better drained and more accessible sites. Principal agricultural pursuits include dairying and flax production with cereal grains and potatoes supplementing the dairying industry.

Future economic possibilities within the region, barring unforeseeable developments such as a successful drainage of swamplands or the finding of economic uses of peat, will probably be a continuation of present-day land use. Farming will tend to increase slightly in acreage but will not overshadow forestry. Thus land use in the eastern extension of the Lake Agassiz Plain should remain much as it is now until improved technology and know-how enable man to exert a measure of control over the rigid physical setting.

The St. Lawrence Seaway: Some Considerations of Its Impact

By DONALD F. WOOD*

IN April 1959 the St. Lawrence Seaway and Power Project will be completed. This billion-dollar project consists of a series of seven modern locks for navigation and a hydroelectric plant capable of producing over two million horsepower. The seven new locks will accommodate vessels with 27-foot drafts and these locks will replace 22 obsolete ones that restrict the draft of vessels to 14 feet. The navigation project is being constructed by the United States and Canadian governments; the power project by the State of New York and the Province of Ontario.[1]

The work was begun in 1954 after too many years of debate in the United States, climaxing with Canada's threat to build the Seaway alone. The navigation project was traditionally opposed by all the various transportation groups with which it will compete: the Eastern railroads, the Mississippi barge lines, the Atlantic and Gulf Coast ports, to name but a few. The hydroelectric project was opposed by the coal industry and was delayed by different groups who objected to the various proposals for control and distribution of the power. The pressing need for power and a low-cost means for moving iron ore from Labrador into the Great Lakes, combined with the steady pressure of other Midwest interests, finally overcame the opposition. In so doing, the Seaway supporters in the United States favored, or at least accepted, the principle of self-liquidation of Seaway costs by collection of tolls and consequently the law provides a period of 50 years for amortization.[2]

The coming of the Seaway will signify the opening of North America's "fourth seacoast" and anticipations of the Seaway have created unbridled enthusiasm in nearly every Chamber of Commerce organization in the Great Lakes area. An avalanche of prognostications as to its impact has been released. The overall impact of the Seaway can be neither accurately predicted nor measured; not because it is so large but because it is so complex. This article points out how the Seaway is expected to affect certain geographic and economic interests.

The New 'Ocean' Ports

It is a natural law of ocean shipping for vessels to penetrate as far inland as possible so they can spread the influence of low cost water transportation into the midst of rich markets. This the Seaway will allow them to do. Yet it is just as natural for a ship to go no further inland than is necessary to meet the cargo; and one can see from the map that the route to the head of the Great Lakes is no straight line. There are locks, canals, channels, circuitous routes, and too many ports demanding regular service, all of which add to operating costs of vessels and the costs must be reflected in rates. There are ships and there is cargo. At which ports will they meet?

Montreal stands as the present terminus of ocean freighters and has served as the interchange point for land and ocean carriers. Its future is uncertain. It

* University of Wisconsin.

[1] See Martin Glaeser, "The St. Lawrence Seaway and Power Project," *Land Economics*, November 1954, for a background of the economic and political events leading up to the Seaway Act of 1954 which authorized and appropriated funds for United States participation.

[2] Public Law 358, 83d Congress.

could be bypassed as Quebec once was or it could remain as the transfer point, especially for cargoes carried on larger and faster ocean vessels which could draw as much as 35 feet up to Montreal and which would prefer not to be slowed down by the various impedimenta beyond. Montreal would be the logical trans-shipment point for bulk cargo between lake carriers and ocean vessels.

Toronto and Hamilton stand at the western end of Lake Ontario, although perhaps too close together for both to derive maximum benefits from the Seaway. Should bottlenecks or delays develop at the Welland Canal[3] these two ports might become turn-around points for ocean ships. All three Canadian ports are expanding their waterfront facilities.

The Seaway will be especially significant to the Lake Erie ports in terms of bulk cargo.[4] The area from Pittsburgh to Detroit contains nearly one-half of the steel capacity of the United States and will be the prime beneficiary of the iron ore movements from Labrador. To the east of Cleveland along the shore there are numerous chemical producers and they can use the Seaway for receiving shipments of raw materials. Toledo is the inland hub of coal-carrying railroads. Detroit, Cleveland, and Toledo are already handling substantial tonnages of high grade cargo which is moving over the present St. Lawrence system. Toledo and Detroit stand at the western terminus of Lake Erie and would be used as the turn-around points for ships which preferred not to make the time-consuming voyage to Lake Michigan ports. There are instances at the present time where the small ships plying the Great Lakes-overseas route do this and ship in their cargo destined to Lake Michigan ports by rail. These two ports will also have a temporary advantage over the ports on the Upper Lakes until the connecting channels between them are dredged to Seaway depths.

Buffalo is the one Lake Erie port which has little to look forward to from the Seaway. It will no longer be the eastern water terminus of United States export grain movements. However its grain storage facilities were constructed at costs much lower than are being experienced elsewhere today and lower charges there will result in the storage of that wheat awaiting better markets. Ports on Lake Erie are doing little to expand their general cargo-handling facilities but instead are waiting to see the increased traffic load first. To a certain extent this is prudent, but in so doing they not only might see the traffic develop but they might see the traffic sail past them to the ports which made better preparations.

It would appear from a look at the map, and taking into account the various hindrances that have been listed, that there are many reasons for a ship, especially a liner carrying high grade cargo, to turn around at some point short of Lake Michigan. Such will not be the case. In addition to the ocean shipping principle of inland penetration, ships do follow the cargo and Lake Michigan is where valuable cargo is. In 1956 Lake Michigan ports handled two-thirds of the tonnage moving in foreign trade between United States Great Lakes ports and other continents.[5] The ports on the western shore of Lake Michigan serve a common hinterland extending to the Rocky Mountains.

Chicago is, and appears likely to be, the foremost Great Lakes port in terms of

[3] Discussed later in this text.

[4] As used in this article the term *bulk* cargo means cargo such as iron ore, coal, stone, grains, and petroleum, with the connotation that it has lower value per unit of measure than *general* cargo such as machinery.

[5] Computed from United States Bureau of the Census, *United States Foreign Waterborne Commerce: Great Lakes Area, 1956*, Washington, D. C., September 1957.

THOUSAND ISLANDS SECTION
68 MILES
INTERNATIONAL RAPIDS SECTION
44 MILES
LAKE ST. FRANCIS SECTION
30 MILES
SOULANGES SECTION
16 MILES
LACHINE SECTION
31 MILES
MAP OF
GREAT LAKES-SAINT LAWRENCE
SEAWAY PROJECTS
ISSUED BY
SAINT LAWRENCE SEAWAY DEVELOPMENT CORPORATION
LEWIS G. CASTLE
Administrator
M. W. OETTERSHAGEN
Deputy Administrator
RAYMOND F. STELLAR
Chief Engineer
Construction of the Seaway Project, Lake Erie to Montreal, is being performed on a cooperative basis by
The Saint Lawrence Seaway Development Corporation
of the United States
and
The St. Lawrence Seaway Authority of Canada
MARCH 1957
SAILING DISTANCES IN MILES
GREAT LAKES
SAULT STE. MARIE TO DETROIT
WELLAND CANAL AND RIVER
WELLAND CANAL TO MONTREAL
TORONTO TO MONTREAL
TORONTO TO PORT COLBORNE
QUEBEC TO STRAIT OF BELLE ISLE (ATLANTIC OCEAN)
DULUTH TO ATLANTIC OCEAN
CHICAGO TO ATLANTIC OCEAN
TOLEDO TO ATLANTIC OCEAN
MONTREAL TO ATLANTIC OCEAN
SEVEN ISLANDS TO ANTICOSTI ISLAND
SEVEN ISLANDS TO DETROIT
SEVEN ISLANDS TO CHICAGO
ONTARIO
QUEBEC
PENNA.
OHIO
IND.
ILL.
WIS.
MICH.
N.Y.
N.J.
VT.
N.H.
ME.
N.B.
NOVA SCOTIA
LABRADOR
SEAWAY PROFILE
INTERNATIONAL RAPIDS SECTION
GREAT LAKES--SEAWAY PROFILE
SAINT LAWRENCE SEAWAY
WELLAND CANAL
SAULT STE. MARIE
PORT ARTHUR
FORT WILLIAM
ESCANABA
GREEN BAY
MILWAUKEE
CHICAGO
GARY
MUSKEGON
PORT HURON
SARNIA
DETROIT
TOLEDO
SANDUSKY
LORAIN
CLEVELAND
ASHTABULA
ERIE
CONNEAUT
BUFFALO
ROCHESTER
OSWEGO
ALBANY
NEW YORK
TORONTO
HAMILTON
KINGSTON
CAPE VINCENT
MASSENA
OGDENSBURG
CORNWALL
IROQUOIS
MONTREAL
THREE RIVERS
SAINT LAWRENCE RIVER
QUEBEC
FATHER POINT
SEVEN ISLANDS
ANTICOSTI ISLE
GULF OF ST. LAWRENCE
PRESCOTT
OGDENSBURG
MASSENA
CORNWALL
IROQUOIS DAM
POWER HOUSE DAM
SPILLWAY DAM
ST REGIS
LAKE ONTARIO
LAKE ST. FRANCIS
LAKE ST. LOUIS
MONTREAL
LACHINE
CLAYTON
THOUSAND ISLANDS INTERNATIONAL BRIDGE
ALEXANDRIA BAY
LAKE ONTARIO LEVEL
IROQUOIS LOCK
UPPER POOL
DWIGHT D. EISENHOWER LOCK
INTERMEDIATE POOL
GRASSE R. LOCK
LOWER POOL
SAULT STE MARIE
MICHIGAN
HURON
ST CLAIR
LAKE ERIE
INTERNATIONAL RAPIDS SECTION
SAINT LAWRENCE RIVER
SOULANGES
LACHINE
SEA LEVEL
SCALE OF MILES
SCALE OF FEET
GREAT LAKES
CONNECTING CHANNELS
(ST. MARY'S RIVER, STRAITS OF MACKINAC, ST. CLAIR RIVER, LAKE ST. CLAIR AND DETROIT RIVER)
EXISTING DEPTH 21 FEET
CONSTRUCTED AND MAINTAINED BY U.S. ARMY CORPS OF ENGINEERS. U.S. AND THE EIGHTY-FOURTH CONGRESS AUTHORIZED THESE CHANNELS BE DEEPENED TO 27 FEET MINIMUM.
THE U.S. WILL REMOVE BEATTY-VILLE SHOAL TO PROVIDE DEPTH OF AT LEAST 27 FEET. THE MINIMUM CHANNEL WIDTH WILL BE 600 FEET OR GENERALLY 1000 FEET IN CURVES
THE U.S. WILL CONSTRUCT TWO MILE LONG SAULT CANAL WITH 27 FOOT MINIMUM DEPTH, INCLUDING TWO LOCKS 80 X 860 FEET, AND CONNECTING WORKS
CANADA WILL DREDGE FROM PRESENT 14 FOOT MINIMUM DEPTH TO 27 FOOT MINIMUM DEPTH, INCLUDING TWO LOCKS 80 X 860 FEET
CANADA WILL DREDGE NEW 27 FOOT MINIMUM CHANNEL IN BEAUHARNOIS CANAL AND CONSTRUCT NEW RAM CHANNEL 18 MI. LONG, 800 FEET WIDE
CANADA WILL CONSTRUCT NEW RAM CHANNEL 18 MI. LONG, 800 FEET WIDE, 27 FEET DEEP, INCLUDING TWO LOCKS 80 X 860 FEET
CANADA WILL DEEPEN THE SEVEN EXISTING LIFT LOCKS ARE 80 X 860 X 30 DEEP
WELLAND CANAL
CANADA WILL DEEPEN THE WELLAND CANAL TO 27 FEET
CANADA WILL CONSTRUCT NEW 27 FOOT MINIMUM DEPTH CHANNEL IN LAKE ST. FRANCIS
CANADA WILL CONSTRUCT NEW 27 FOOT MINIMUM DEPTH CHANNEL IN LAKE ST. LOUIS
CANADA WILL CONSTRUCT NEW 27 FOOT MINIMUM DEPTH CHANNEL IN LAKE ONTARIO
NOTE: POWER DEVELOPMENT IN INTERNATIONAL RAPIDS SECTION BY THE POWER AUTHORITY OF THE STATE OF NEW YORK AND THE HYDRO ELECTRIC POWER COMMISSION OF ONTARIO.
SEAWAY PROFILE
INTERNATIONAL RAPIDS SECTION
(MEAN FIGURES ARE SHOWN FOR ELEVATIONS)
GREAT LAKES--SEAWAY PROFILE
LAKE ONTARIO LEVEL EL 246
UPPER POOL EL 243
INTERMEDIATE POOL EL 243
LOWER POOL EL 243
SUPERIOR EL 602
MICHIGAN HURON EL 581
ST CLAIR EL 574
ERIE EL 571
INTERNATIONAL RAPIDS SECTION
ONTARIO EL 246
SAINT LAWRENCE RIVER EL 230
SEA LEVEL
SOULANGES
LACHINE

overseas tonnage. It is the rail and truck hub of the continent and the Illinois Waterway leading to the Mississippi is being greatly improved. About five miles inland on the Calumet River near its junction with the Illinois Waterway is Lake Calumet which has been converted into a harbor with modern facilities costing over 24 million dollars.[6] Chicago will handle the largest tonnage for two reasons. It is the center of the transportation network of the continent. Because of its concentration of population and industry it is a giant consuming and producing area.

Chicago's size may prove to be a mixed blessing in relation to cargo handling because with size comes rail and truck congestion which results in expensive delays for high grade cargo and prevents meeting scheduled sailings. At present the channel leading into Lake Calumet, spanned by over a dozen bridges which must be moved to allow a ship to pass, is somewhat restrictive to the free passage of vessels. Development of general cargo facilities in Chicago Harbor, on Lake Michigan near downtown Chicago, would provide a better location for mooring ocean liners. Unfortunately, there is no good landward access from that point, especially for trucks.

Milwaukee will be Chicago's principal competitor for high grade cargo. Milwaukee has superior facilities for handling certain types of cargo and these facilities have resulted in the routing of some traffic through Milwaukee which comes not only from Chicago's hinterland but from Chicago itself. Milwaukee is spending six million dollars for a general cargo terminal and several additional millions on other harbor developments, especially improvements in highway connections. Milwaukee and Chicago serve a common hinterland and in many instances rail and truck rates to the ports are equal; hence the competition will be based mostly on quality of service.

Green Bay handles a large overseas tonnage, especially in comparison with much more populous Great Lakes ports. Most of the current traffic is large shipments of high grade bulk cargo and much of Green Bay's traffic comes from serving a hinterland. Private facilities are being expanded. At present Green Bay is not a port of call for regularly scheduled liners as are Milwaukee and Chicago but this handicap could be overcome when the Seaway opens the lakes to more ships. A peninsula of land lengthens the voyage for any liner calling at both Green Bay and one of the larger ports to its south. Despite their differences in size, facilities, and resources, these three ports on the western shore of Lake Michigan will be competing vigorously for the traffic of a prosperous hinterland.

At present there is little overseas cargo moving to or from Lake Superior ports, especially high grade general cargo items. Liner service to Lake Superior ports will not be established until there can be substantial and regular offerings of high grade goods. Overseas grain shipments from these ports should increase and it appears that the development of taconite will keep a steady stream of ore flowing from them to other Great Lakes ports in spite of the declining Mesabi reserves.

The optimum number of Great Lakes ports which can or should expect to receive regularly scheduled overseas service cannot be established arbitrarily. There must be enough ports so that the total volume of cargo they all can offer will be enough to attract ships into the lakes; yet, if a vessel must make too many stops, this will be reflected in its rates. Smaller ports with little hinterland have little

[6] Harold M. Mayer, *The Port of Chicago and the St. Lawrence Seaway* (Chicago: University of Chicago Press, 1957), chapter 9.

hope of generating or being able to offer enough high grade cargo to entice scheduled liners to stop or to keep local stevedores fully occupied. However, many of these ports have one asset which larger port cities lost long ago and that is waterfront locations for commercial or industrial development.

Changes in Movements of Bulk Cargoes

In July 1957 the consultant for the St. Lawrence Seaway Development Corporation stated that studies indicated a total cargo tonnage of 17 million tons in 1959; 34.8 million tons in 1960; 44 million tons in 1962; and 53.4 million tons in 1965.[7] Numerous and varying predictions have been made concerning the expected tonnages of different commodities.[8] All predict large tonnages of iron ore and grain and smaller, but substantial, tonnages of coal, petroleum, pulpwood and wood pulp, nonferrous ores and general cargo.

The Great Lakes steel industry should get much of the credit for the final success of the Seaway because the support they gave the other proponents resulted in tipping the scales in their common favor. They were also able to insert the magic term "for national defense" into the argument. The steel industry had been faced with a supply of Mesabi ore which was diminishing in both quality and quantity and different companies in the industry sought out new sources. Some companies developed claims in South America; other companies, especially those located near Lake Erie, developed the rich claims in Labrador. Without the Seaway, the inland steel industry might have relocated, or at least expanded, elsewhere.

While production of iron ore in the United States has shown no particular increase since World War II, ore imports increased from five million tons in 1947 to 34 million tons in 1956. In 1956 the ore imports equalled about 30 percent of domestic production. Ore from Canada made up 45 percent of that imported.[9] Iron ore imports into the United States have been increasing even more rapidly than was predicted by members of the steel industry who had favored the Seaway prior to the Seaway Act.[10] In 1956 the Labrador ore properties completed their second full year of operations and over 13 million tons of ore, representing an increase of nearly 69 percent over 1955, were loaded at Seven Islands. Over 2.5 million tons of that total were moved through the present St. Lawrence route into the Great Lakes.[11] By July 1957 movements of iron ore through the St. Lawrence were nearly ten percent above those for the corresponding period in 1956.[12]

The agricultural interests of the Midwest had been proponents of the Seaway in the hope that savings from shipping via that route would open new markets for their products, especially their grains. Joseph R. Hartley, of Indiana University, whose work has been referred to above, has computed the effects the Seaway may have in diverting grain traffic from Gulf and Atlantic ports. He stated that the Seaway would mean savings of about 18 cents per bushel on export wheat in comparison with present methods of shipping via an

[7] *Traffic World*, July 27, 1957. The consultant was Dr. John Hazard. Tonnage figures herein are net tons.

[8] Joseph R. Hartley, *The Effects of the St. Lawrence Seaway on Grain Movements* (Bloomington, Indiana: Indiana University Bureau of Business Research, 1957), p. 93.

[9] Computed from *Annual Statistical Report of the American Iron and Steel Institute, 1956*, New York City.

[10] See, for example, hearings before Subcommittee of the Committee on Foreign Relations 83rd Congress (1953) on S. 589.

[11] Lake Carriers Association, *Annual Report 1956*,, Cleveland, Ohio, p. 73. The ore was transferred to smaller canal vessels before moving through the 14-foot channels.

[12] Dominion Bureau of Statistics, *Summary of Canal Statistics, July 1957*, Ottawa, Canada.

Atlantic port.[13] He concluded that the Atlantic ports might lose nearly one-half of their current export grain volume and the Gulf ports, some 30 percent.[14] He picked Chicago to have the largest export grain volume of any Seaway port, ranging from 2.4 million to 3.3 million tons in the mid-1960's. Duluth would be second with 1.5 to 2.1 million tons. He predicted that Toledo and especially Milwaukee may become important grain export ports.[15] Grain will move downstream on lake carriers for transfer to ocean ships on the ocean side of the Seaway or it will move all the way out on tramp steamers or as "bottoming" cargo on scheduled liners. In the last instance the liners would take on grain at ports with general cargo offerings. More recently, Hartley's predictions have come under criticism as being too liberal.[16] In 1956 over 2.5 million tons of wheat and 1.5 million tons of other grains moved down the present St. Lawrence system. The total tonnage of grains carried through the canals and locks, including an extremely small amount upbound, represented a 20-percent increase over 1955. Movements through July of 1957 were 21 percent behind those of the same period in 1956.[17]

Powdered milk, cheese, and animal feeds are moving out from Great Lakes ports. They represent commodities purchased by the United States government under various agricultural price support programs that are usually donated or sold at low cost to relief organizations which ship the goods to various parts of the world. These cargoes can be expected to increase in 1959 because of both lower transport costs and the entry of vessels flying the United States flag into the Great Lakes-overseas trade.[18] The Seaway could result in reducing some of the huge stocks of surplus agricultural commodities which tend to depress domestic farm prices.

The coal industry opposed the St. Lawrence Project for two reasons: it feared the Seaway would open the Great Lakes to a flow of foreign oil and that the accompanying hydroelectric project would displace part of the demand for coal. United States bituminous coal exports amounted to over 68 million tons in 1956, of which 41 million tons went to Europe and 20 million tons went to Canada.[19] Of that moving to Canada 1.7 million tons was shipped downstream through the present St. Lawrence route.[20] The coal movements on this route increased ten percent over those for 1955; and through July of 1957 they were 30 percent higher than for the corresponding 1956 period.[21]

Export shipments of coal had been declining through 1954 but rose some in 1955 and rose sharply in 1956 because of the oil shortage in Europe. Both Canada and Europe are attempting to shift to oil economies but uncertainties in the Middle East may delay the change-over. The Seaway should result in substantial tonnages of coal moving from Lake Erie ports, especially Toledo, to eastern Canada. This coal would be carried as a "backhaul" by vessels which carried ore from Labrador into Lake Erie. The level of toll charges might very well determine if coal from Lake Erie ports will be shipped to Europe.

[13] Hartley, p. 174.
[14] *Ibid.*, p. 223.
[15] *Ibid.*, pp. 231-234.
[16] See, United States Department of Agriculture, *Potentials of the St. Lawrence Seaway for Marketing United States Agricultural Commodities*, Washington, D. C., July 1957.
[17] Dominion Bureau of Statistics, *Summary of Canal Statistics July 1957* and *Canal Statistics 1956.*
[18] Fifty percent of all cargo financed by government credits must be carried on United States ships. See *The Wall Street Journal* (Midwest Edition) August 13, 1957.
[19] Compiled by Coal Exporters Association of the United States, Inc., Washington, D. C.
[20] Dominion Bureau of Statistics, *Canal Statistics 1956.*
[21] *Ibid.*, and *Summary of Canal Statistics July 1957.* A very small tonnage upbound is included in the total movements. In 1956 it represented 1.6 percent of the total.

In 1956 nearly 1.5 million tons of petroleum and petroleum products moved through the present St. Lawrence system, most of it upstream.[22] However, the new Seaway will have little effect on the existing patterns of petroleum movements other than to supplement pipeline movements. The Seaway will not be able to accommodate a fully laden supertanker and, if new tankers are built specifically for this route, they will be at a competitive disadvantage with larger ocean tankers on the high seas when the Seaway will be closed to navigation by winter weather. If ocean tankers are counted upon to supply the Great Lakes area, stockpiling for the closed season each winter will require extensive investment in both storage facilities and inventories. Moreover, the closed season will be the period of greatest demand for the product.

Nearly 500 thousand tons of pulpwood moved via the present 14-foot locks in 1956 from eastern Canada to the Great Lakes area for use in the manufacture of wood pulp for paper in both the United States and Canada.[23] Anti-stream pollution restrictions on the disposal of wastes incurred in the pulp-making stage of paper manufacturing have caused some of these operations to be transferred away from the Midwest to points nearer the new sources of supply, where limitations are fewer. Over 55 thousand tons of wood pulp were shipped through the St. Lawrence in 1956, half again as much as moved in 1955.[24] The new Seaway will have a similar significance to both the paper and steel industry located in the Great Lakes area. Originally both located near their raw materials, but nearby supplies have been depleted, leaving expensive plants and facilities located far from new sources. The Seaway will allow them to maintain their competitive position.

Industrial Development

The Seaway's role in industrial development of the Great Lakes area is and probably always will be questioned. As already mentioned, the Seaway will allow industries which otherwise would have been forced to relocate elsewhere to remain in the Great Lakes area. These industries are expanding but not always in the Midwest. Upstate New York is already experiencing industrial expansion because of the power project. Half of the output of New York's share of the power is expected to go to two huge aluminum reduction plants.[25] However, there is little other industrial development in the Great Lakes area which can be attributed directly to the Seaway despite what is said by local development or Seaway boosters.

But industrial development in the Midwest is booming. Over the past five years one-third of the nation's new plant spending has been funneled into Illinois, Indiana, Michigan, Ohio, Missouri, Iowa, Wisconsin, and Minnesota; twice as much as went to the runner-up Middle Atlantic states.[26] It may be that the Seaway's real significance to development of industry in the Midwest will prove to have been indirect. Perhaps it has served only to excite the region's imagination, but in so doing "has served as a rallying-point for Great Lakes interests and set off a widespread drive toward industrial development."[27]

[22] *Ibid.*

[23] *Ibid.*

[24] *Ibid.* Over 97 percent of the wood pulp moved upstream. Tonnages for both pulpwood and wood pulp through July 1957 were down in comparison with the same 1956 period.

[25] Power Authority of The State of New York, *Power Marketing*, New York City, 1957.

[26] *The Wall Street Journal* (Midwest Edition) March 21, 1957.

[27] Federal Reserve Bank of Boston, *New England Business Review*, July 1956.

This does not mean that manufacturers in the Midwest will not benefit directly from the Seaway. They already enjoy some benefits from direct water shipping by making use of the present liners which use the 14-foot channels to connect the Great lakes with overseas areas. The new Seaway will bring more or expand original benefits.

Present direct savings come from lower combined land-water freight rates in comparison with the combined rates of shipping via either Atlantic or Gulf ports. On the basis of these savings alone some midwestern manufacturers will gladly testify that they have been able to compete more vigorously against both foreign and United States sellers to make more sales in overseas markets; and they look forward to larger and faster ships sailing to more foreign ports of call. Such examples show that the savings from shipping via the St. Lawrence route will serve to *generate* some new traffic.

Other savings come from having to use less or no packing and from more careful handling of cargo at Great Lakes ports than is the case with some shipments moving via seaboard ports. Damage and pilferage are less prevalent. This in itself is a tremendous advantage when applied to high grade cargo. Using this route also enables sales in countries with dollar restrictions. If the cargo is carried on a foreign ship, the ship can be paid in foreign dollars, whereas the rail charges from the Midwest to a seaboard port must be paid in United States dollars.

There are a few obstacles which do and will prevent Midwest manufacturers from utilizing the Seaway as much as might be expected. Inertia prevents many firms from switching from coastal ports to Great Lakes ports even though they are aware of the savings. In some instances overseas customers purchase *f.o.b.* factory and will specify movement via the coast even though the seller has pointed out the possible savings. Most firms still utilize the foreign banking, customs brokerage, and freight forwarding services located in coastal ports and these groups have been effective in persuading the firms not to change. The firms will have to continue to use the coastal ports during the Seaway's closed winter season, and some will prefer not to change routings twice a year.

In addition, the Atlantic and Gulf ports and the railroads serving them will do everything in their power to keep the present flow of high grade freight from being handled by others. They may have to resign themselves to losing low grade bulk traffic to the Seaway but they will be able to compete very effectively, in terms of rates and services, for general cargo. Even this is to the advantage of the Midwestern shipper for, although he may choose not to use the Seaway for shipments to his foreign markets, he will enjoy the indirect benefits from the Seaway as being a *rail rate regulator*.[28]

A more serious obstacle presenting itself is the levelling off, if not decline, of the European market for United States goods. The St. Lawrence route points nearly directly to Western Europe. Lake Erie ports are no further from there than are the Atlantic ports. This is the only overseas market area of the world to which the St. Lawrence route presents definite savings in distance. To other areas the transportation savings must come mostly from differing inland rail or truck rates. The European *common market* plan will mean that fewer United States exports can be sold there unless the plan brings so much prosperity to Europe that its demand for imports will pick up again. A large proportion of the

[28] This could be a mixed blessing. While rates on hauls competing with the Seaway might be lowered, the losses in revenue would have to be made up elsewhere.

manufactured goods moving out through the Seaway will have to be headed for the Caribbean, South America, Africa, and the Middle East. Such a shift from European markets might occur naturally because these other areas represent potential sources of raw materials for Midwest industry.

The Seaway will, of course, open up the Midwest to a stream of foreign manufactured goods. Already considerable quantities of both producers' and consumers' goods are flowing in through Great Lakes ports. In 1956 substantial tonnages of fancy foods and foodstuffs, liquors and wines, fiber manufacturers, plywood, newsprint, cement, glass, steel and steel mill products, hardware, utensils, electrical apparatus, machine tools, machinery, agricultural implements, automobiles, coal tar products, and industrial chemicals were received by Great Lakes ports from overseas origins.[29] Buyers will benefit; there can be no doubt of that. But what about domestic manufacturers of identical or competing products? All that can be said is that, if they export to overseas areas, they receive the same advantage from the Seaway as do their foreign based competitors who ship goods into the United States.

Effect on Carriers

It is doubtful that any one economic group has the distinction of as many years of active Seaway opposition as do the Eastern trunk railroads. Holders of a near monopoly on the long haul traffic, especially of bulk cargo, between the Midwest and the Atlantic Coast, they feared and fought anything which would deprive them of it. The Seaway will hurt them. A prominent investment firm stated in 1954 that the amount of money which the *proponents* of the Seaway conceded the Eastern railroads would lose amounted to over four percent of the total gross revenues of Class I railroads operating in the Eastern District.[30] Second only to the railroads in opposition were the Atlantic port cities and the organizations of steamship lines serving them. Prior to World War II, *exclusive patronage contracts* were employed which granted lower rates to those export shippers who would agree to deliver all of their export tonnage to lines belonging to North Atlantic steamship conferences at Atlantic seaboard ports. There were penalty rates which would be applied if it were discovered that the shipper was sending even small shipments via the Great Lakes-ocean route. This practice was halted in 1939 by the Federal Maritime Commission's Docket 513 order. This docket represents the first successful attempt to undermine the powerful position of those transportation interests opposing the Seaway.

The advent of the Seaway will mean two different things to two sets of railroads. While those in the East will be hurt, those serving the area west of Lake Michigan have everything to gain and very little to lose. They will carry a share of any new traffic the Seaway generates and they will earn more revenue from the shorter haul to Lake Michigan ports than they do from sharing the proceeds of a joint rate with an Eastern trunk railroad. Railroads serving the area west of Lake Michigan are discouraged from encouraging more export traffic to move via lake ports by pressure from other railroads in tariff regional committees.

Several valuable concessions have been won. The first export rate to a Great Lakes port was established to Milwaukee

[29] United States Bureau of the Census, *op. cit.*

[30] Merrill Lynch, Pierce, Fenner & Beane, *Potential Effects of the St. Lawrence Seaway*, New York City, July 1954. They compiled their findings from a figure expressed in the *minority* views of the House of Representatives.

in 1955.[31] By the end of 1957 nearly ten such rates had been established by rail and motor carriers to Great Lakes ports, especially Milwaukee and Chicago. While the number is small it is significant because each one of them represents a special concession. Another victory, which was won in 1957, was the recommendation of an Interstate Commerce Commission examiner that seven days' free time before demurrage charges be granted on rail cars carrying export freight to Great Lakes ports. This put them on an equal basis with the ports on the seaboard.

The Atlantic and Gulf ports are carrying on extensive and expensive expansion programs, either because of or in spite of the Seaway. They appear to be less pessimistic than they once were.[32] One advantage is that with their harbors being much deeper than the Seaway they alone will be able to handle the large new *supertankers* and other deeper draft vessels which are being built.

The highway carriers, especially those serving the Great Lakes ports, look forward to handling the inland movements of the general cargo passing through the Seaway. The Great Lakes ports which are expanding their facilities are providing adequate highway connections because around most modern general cargo port terminals "from 50 to 70 percent of the landward movement occurs by motor truck, and this proportion is increasing."[33] The truckers feel that they can compete quite effectively with railroads for a distance up to 250 miles from any lake port.[34] Truck lines operating between the Midwest and coastal ports will be affected less than will the railroads, principally because they have little or no fixed investment holding them to one spot. Their advantage in competing with the Seaway will be faster service but their disadvantage will be the cost.

Foreign steamship services have had great faith in the potentialities of the development of Great Lakes-overseas commerce and have already demonstrated it by investing millions of dollars in developing service. During the 1956 season 125 vessels completed 334 trips to overseas destinations, representing a slight increase over the previous year. They flew the flags of Canada, Costa Rica, Finland, France, Germany, Great Britain, Italy, the Netherlands, Norway, Panama, and Sweden.[35] The Fjell line began scheduled service into the Great Lakes as early as 1933 and another line entered in 1937, both of which terminated service at the outbreak of World War II. After the war, the Fjell line was again the first one to establish service and since then has been joined by many others.[36]

Most of the vessels in use are quite modern. Many of then draw 21 feet when carrying 3,000 tons but at present can carry only one-half that amount when passing through the 14-foot locks. Some are constructed so that they can be readily lengthened by having another hold added in the center. These vessels will continue to operate on the route but will be joined by larger vessels which will be able to carry up to 8,500 tons and draw 27 feet of water. No one size or class will predominate. On open water the larger vessel can be operated more economically per cargo-ton, but smaller vessels will have an advantage on the operations in the lakes for some time to come.

During the 1957 season there were about three scheduled sailings a week

[31] Mayer, *op. cit.*, p. 91. An export rate is a rate usually lower than the domestic rate to encourage movement of export traffic.
[32] *The New York Times*, June 2, 1957.
[33] Mayer, p. 201.
[34] Chicago Bar Association, *Chicago Bar Record*, May 1957.
[35] Lake Carriers Association, *op. cit.*, pp. 55-60.
[36] Mayer, p. 64.

from major Great Lakes ports to the European Continent, two a week to Scandinavia, two a week to the United Kingdom, and much less frequent service to the Mediterranean and the Caribbean.

A number of the lines are operating this service at a loss and there is not enough cargo offered for them to even load to the limited capacity the locks will permit.[37] At Toronto one European line let it be known that "it stands ready to lose 50,000 dollars a year for five years, just to be sure of a place on the waterfront."[38] This early venturing into the Great Lakes by foreign lines and their motives were vividly described in a Canadian periodical:

"Up in the lakes, shippers and other people calling at the waterfronts in the course of their business day, greet the skippers as old friends. Lavish parties are held aboard ship at times and there is always a friendly chat awaiting the occasional landlubber when a foreign ship calls. Most ship captains are hospitable, according to tradition, and there has been particular reason in the last 15-odd years not to stint on entertainment. Their aim is a slice of the business which is expected from the lakes."[39]

The Federal Maritime Administration has established two "essential" Great Lakes-overseas trade routes. United States flag lines which would operate on these routes and meet the various criteria of the Maritime Act would be eligible to receive an *operating differential* subsidy to put them on a parity with lower cost foreign shipping. Specifications for the trade routes in 1959 and subsequent years call for the following approximate number of monthly sailings during the open season: trade route 32, eight to twelve sailings to the United Kingdom and Atlantic Europe and three to four sailings to the Baltic-Scandinavian area; trade route 33, four sailings to the North Coast of South America and two sailings to Cuba and other islands in the Greater Antilles.

Less rigorous specifications had been set for the 1957 and 1958 seasons with the hope that United States lines would charter small vessels out of the "moth ball" fleet. However, the high costs of reconditioning the vessels discouraged the lines from acting, especially because they would have no use for the small vessels after the Seaway opened. It is now doubtful that United States lines will institute service before 1959.[40]

The potentialities for the development of domestic shipments between United States coastal and Great Lakes ports are difficult to forecast. Although the route is circuitous it might represent savings over rail or barge shipments. At present, cargo on barges moving from the Gulf up to Chicago via inland waterways are usually transferred to lake vessels for shipment to other Great Lakes ports.

Limitations on Traffic

The most obvious limitation is the closed winter season during which no traffic can move. The open season usually runs from late April until early December. Thus, the Seaway itself and many harbor facilities built for Seaway trade must either stand idle or at least not be fully utilized for over four months of the year. Both early and late in the open season there is a deluge of very high grade cargo. In the spring it represents a backlog and in the fall it represents extra shipments for keeping overseas warehouses and buyers supplied during the closed season. Both are attempts to save the higher costs of shipping via the coast during the closed season. This means that lower grade cargo is refused early and late in the season and hence shippers

[37] *The New York Times, op. cit.*
[38] *Newsweek*, August 6, 1956.
[39] *The Montrealer*, August 1956.
[40] Statement of the Maritime Administrator, August 8, 1957.

of it will have an even shorter open season.

The second limitation may be the current capacity of the Welland Canal which is estimated to be 45 million tons, about 10 million tons less than that of the new Seaway. In 1956 the Welland handled 23 million tons of traffic, 10 million tons more than did the present St. Lawrence system and this interlake traffic must also be taken into account. The Welland presently consists of eight locks, three of which are doubled to permit two-way traffic flow. One cost estimate of doubling the other five and widening the channel is 125 to 150 million dollars.[41] The Welland system can handle the same size ship as will the new Seaway. The Welland is on Canadian soil and under Canadian control.

The connecting channels between Lakes Erie and Huron, and Lake Huron and Lakes Michigan and Superior must also be dredged to 27-foot depths. The present depths are 25 feet downbound and 21 feet upbound; the difference is to accommodate fully loaded ore boats from Lake Superior. This job is being undertaken by the United States at an estimated cost of nearly 136 million dollars.[42] Around 18 million dollars has already been appropriated for the work between Lakes Erie and Huron. If sufficient funds are available the work will be completed in 1962.[43]

The Great Lakes harbors must also be dredged to Seaway depths. Most major Lake Erie harbors are dredged to between 22 and 25 feet while the Lake Michigan harbors are several feet more shallow. The Corps of Army Engineers is currently making studies to determine priorities for the work, which will be done at federal expense. Opponents of the Seaway have contended that these connecting channel and harbor dredging costs should be added to Seaway costs. However, most of this work was and can be justified solely on the basis on interlake traffic.

The last limitation is the water level of the Great Lakes, which though always fluctuating, has been receding in the past five years. The diversion of water from the Great Lakes at Chicago for diluting treated sewage and freeing navigation has not helped the situation. Any lowering of the water levels negates the effects of expensive dredging. Continued or increased diversion at Chicago would give Canada an excuse for diversion of water from the Columbia River in the Pacific Northwest.[44]

Costs and Tolls

In 1954 the total cost of the Seaway was expected to be around 300 million dollars, two-thirds of which would be paid by Canada and one-third by the United States. The St. Lawrence Seaway Development Corporation was given authority to borrow up to 105 million dollars from the United States treasury.[45] In early 1957 the Corporation returned to Congress to ask for an increase in borrowing authority to 140 million dollars, representing a 33 percent rise.[46] There were several factors responsible. The first was inflation. The index of construction costs had risen over 20 percent between the original estimates and 1957. Several other items of expense normally borne by other units of government in large construction projects

[41] *The Chicago Daily Tribune*, February 13, 1956, part 4, p. 6. Estimate made by official of the St. Lawrence Seaway Development Corporation.

[42] Public Works Appropriation Bill (Fiscal) 1958, 85th Congress 1st session, Senate Report No. 609.

[43] *The New York Times*, May 29, 1957.

[44] *The Milwaukee Journal*, August 25, 1957.

[45] See *St. Lawrence Seaway Manual*, 83d Congress 2d session, Document No. 165.

[46] See *Hearings before the Committee on Public Works*, House of Representatives, 85th Congress, 1st session, April 1957.

were, in this instance, shifted to the Corporation. An example is a 3-million-dollar item for installing navigation aids, which is usually done by the Coast Guard. Six million dollars was added to dredge a certain section which, through ambiguities in various agreements, was shifted from the power entity to the Corporation.

The remainder of the increase came from additional facilities needed, and changes in basic planning and design. This is in spite of the deferral of a 21-million-dollar lock and canal. It appears that better estimates could have been made because the savings from the deferral of this last item almost equal the increase due to price escalation. Congress granted the authority to borrow the additional funds, without which the project could not have been finished. These additional funds, plus interest, must still be paid back within the 50-year-amortization period.

Contractors on the project encountered more obstacles than they had anticipated. Several have gone bankrupt or defaulted and there are currently some unsettled claims against the Corporation and the Corps of Engineers, its construction agency.[47]

The St. Lawrence Seaway Authority of Canada experienced similar difficulties and it now estimates its total construction costs to be around 285 million dollars.[48] It is expected that the Authority, in conjunction with its United States counterpart, the Corporation, will announce the tolls in the spring of 1958; an event for which many have been waiting.

A serious controversy between several powerful economic groups has been precipitated by this unexpected rise in construction costs. The problem is the effect, if any, which the amortization of this extra amount will have on tolls. Some of the potential users and beneficiaries have charged that higher tolls would discourage traffic. Some have banded together and others work separately, but their goal is to get the government to assume part of the burden. Included are some whose overall policy on public vs. private enterprise is definitely not characterized by consistency. The agitation of some could almost be interpreted as meaning they *are* going to use the Seaway but are out merely to avoid some of the *user charges*. The Seaway is the first major inland water navigation improvement undertaken by the federal government the cost of which is to be recovered by tolls.

The Association of American Railroads and other former Seaway opponents are aghast at the idea of a subsidized Seaway. They have joined in supporting none other than the St. Lawrence Seaway Development Corporation, which is faithfully carrying out the mandate of Congress. At this writing no evidence has been presented to show that tolls will offset savings from shipping via the St. Lawrence Seaway. There is substantial evidence to the contrary.

A split has developed between groups which at one time supported the Seaway and has brought with it bitterness and personal animosity. It is regrettable that such a split should develop before the St. Lawrence Seaway is finished. For the Seaway should stand as a classic example of what these various groups and interests can accomplish when they work together.

[47] *Engineering News Record*, June 13, 1957 (New York City).
[48] *Traffic World*, October 19, 1957.

An Institutional Innovation to Facilitate Land Use Changes in the Great Plains†

By MARION CLAWSON*

A MAJOR adjustment in land use in the Great Plains is needed but it will not be made under the usual system of single farm private landownership. Land ownership and management systems other than federal land-ownership are possible alternatives to private landownership. The purpose of this article is to suggest one such alternative.

Situation on the Great Plains

The physical and economic characteristics of the Great Plains have been discussed in many writings; the purpose here is not to add to them but to refresh our memories and provide a common background.[1] The Great Plains is a very large area, with highly variable weather conditions. Moreover, variations in annual rainfall and other climatic factors are often around a critical point, above which successful crop production is possible, and below which it is not. The original pattern of private landownership, imported from the humid east, was very poorly suited to the natural conditions of the area, and grew out of unsuitable land laws. Crop yields are highly variable, uncertain, and, under our present knowledge, unpredictable. Wheat is the best cultivated crop for most of the area; but the volume of wheat that can be produced there and elsewhere in the nation is well above our needs. Large parts of the Plains produce wheat intermittently, especially when viewed from any long historical perspective, and the total output from such lands is low. Saunderson has estimated that 40% of the land used for wheat in the northern Plains produces but 10% of the crop.[2]

Grass may be an equally good or better alternative for the poorer crop land. But once land has been plowed for wheat, its return to grass is slow, uncertain, and expensive, especially in dry years when wheat is least successful. By and large, the cost of regrassing land is as great as its value when regrassed, so that land carrying any price must have some subsidy if it is to be regrassed. Along the eastern margin of the Plains, corn is an alternative crop or even the major one and in the southern Plains sorghum becomes important.

Tenant farming, or partial tenancy, serves to keep the crop acreage relatively high. Returns to landlords are often good even when farm operators do poorly. There is a serious erosion problem on much of the land in crops, both wind- and water-caused erosion. A substantial area presently, or recently, in crop should be restored to grass. The United States Soil Conservation Service has estimated this area at 14 million acres; I suspect it is considerably more, but the precise area is immaterial for our

† The views expressed here are wholly personal, and in no way reflect a policy or position of Resources for the Future.

* Resources for the Future.

[1] A listing of even the major studies of the Great Plains would be a major article in itself. *The Future of the Great Plains*, by the Great Plains Committee (Washington: Government Printing Office, 1936) was one major study, with a short bibliography. The *Journal of Farm Economics*, especially the issues of August 1949, November 1949, and August 1950, has many articles directed at the economic and land use problems of the Plains. Historians and geographers' professional journals contain many articles. *Man's Role in Changing the Face of the Earth*, edited by William L. Thomas, has several chapters directed at problems of the Plains, each with bibliography. (See Book Review section, this *journal*.) *Great Plains in Transition*, by Carl F. Kraenzel, is a recent contribution, also with many sources cited. There is an embarrassment of riches in sources relating to the Plains, although, of course, there is much repetition among the various sources.

[2] Mont H. Saunderson, "Range Problems of Marginal Farm Lands," *Journal of Range Management*, January 1952.

present purpose—we may be fairly sure that several million acres are involved.[3]

The foregoing sounds gloomy, listing all the problems and disadvantages of the Plains. But it is also a wonderfully productive area when conditions are favorable. Large and profitable crops of wheat can be harvested in some years. The possibility of large profit is perhaps as compelling a factor in land use of the Plains as any other.

The foregoing is more or less the usual description of the Plains; I would add only one major point. There has been a moderately high turnover of farm operators and landowners in the Plains since the times of earliest settlement. A reliable personal knowledge of the Plains is hardly attainable in less that 25 years' farm operation there; two or more generations in the same family would be better. Very few Plains farmers have had such experience. Experience for five years, or ten, may be highly misleading.

Basic Problem of Plains Agriculture

The basic problem of Plains agriculture is to develop a stable system of farming, capable of withstanding severe and prolonged drouth, and perhaps severe depression as well, without major outside help, and with a minimum of soil erosion.

This problem has not been solved yet. Farming in the Great Plains has undergone several periods of crisis, with either heavy depopulation or with massive assistance, financial and other, from outside areas. The most severe period in the present century was during the 1930's; this was followed by several highly favorable years. In the last few years conditions have been unfavorable again, with outside financial help again necessary. Soil erosion still continues serious, particularly in some areas and in some years.

A full solution to the whole problem of Great Plains agriculture includes many parts, and is beyond the scope of this article. Adjustments in agriculture will require further adjustments in governmental and social services, which will be difficult to make without severe stress. One essential element, however, must be the conversion of Class IV and poorer land (Soil Conservation Service classification) from wheat, or at least from a plowed condition, to grass. Other relatively unproductive land, and small parcels of productive land scattered among generally unproductive areas, perhaps should be shifted in use also.

A land use shift of this kind can be made—in fact, during the later 1930's, several million acres of land were taken out of wheat and seeded to grass or allowed to drift back to it. The real problem is not to put poor wheat land into grass—the real problem is to keep it there, when unusually favorable weather and/or price years come again.

Limitations of Private Ownership

Private ownership of land, in essentially one-farm tracts, cannot bring about and maintain the needed shifts in land use, even when assisted financially by the federal government. The shifts in land can be made, if subsidized sufficiently, but they will not be permanent unless the usual conditions of private landownership are modified in some degree.

Education of private landowners as to the hazards of certain types of land use practices and certain kinds of farming can be of only limited effectiveness. In years or periods when profit possibilities of wheat production are good, few farmers will resist the temptation to plow out grass and gamble on a crop on much land that cannot successfully be

[3] *Facts about Wind Erosion and Dust Storms on the Great Plains*, Leaflet No. 394, United States Department of Agriculture, June 1955.

cropped continuously. With the high turnover of farmers and landowners, a large proportion of them will feel that they know better, based upon their limited experience, than any advisor.

As a nation, we have been unwilling in recent decades to let nature take its course, and to force readjustments in line with longterm possibilities of the Plains. We have bailed out the mistakes, in drouth and depression, and we have subsidized operations in other years. Man has developed permanent means of existence in semi-arid plains with variable weather in other parts of the world and in other centuries. The white man has not made such adjustments on the Great Plains yet and as a nation we have been unwilling to allow forces to this end to run unchecked. Massive subsidies have been given to Plains agriculture and to the residents of the Plains in the past forty years. I know of no calculation of their total, but I suspect it well exceeds that for which all land and its improvements could once have been bought. In my view, comparatively little permanent adjustment of Plains agriculture has occurred. Larger farm units have been a step in the right direction but developing technologies have also raised the size of the economic unit and there are still far too many small units. Some new technologies have been introduced but, on the other side, our subsidies have helped to build a land value structure that impedes further land use adjustment. In times of favorable weather, such as from 1940 nearly to 1950, it seems as if major improvement has been made. A major drouth reveals major flaws again.

A Major Change in Land Ownership

When the limitations of private landownership are enumerated, many persons immediately jump to federal land ownership as the only alternative. This is perhaps natural, the more so because one of the major mechanisms for land use adjustment in the Great Plains in the 1930's was the submarginal land purchase program. It is true that federal purchase of land is one alternative but it is by no means the only alternative to private landownership. The major purpose of this article is to outline another one.

A mixed federal-state-private corporation might be established, to buy, develop, and manage grazing land. Stock shares or other control devices could be used, to share the control equally between the three parties. This would put control effectively in local hands, thus reducing some of the major objections to federal land purchase. At the same time, the major—perhaps the only—source of funds would be from the federal government. These might be in the form of grants, in part, but chiefly and perhaps solely they should be in the form of low interest or interest-free loans—and loans which perhaps would never be paid off. As lender and creditor, the federal government would have complete veto power over the initial and the continuing actions of the mixed corporation. The federal government could veto, but not initiate; the mixed corporation could propose but not act without federal agreement. Stalemate would be possible, but any action would require a minimum of agreement among the various parties.

The major purpose of the mixed corporation would be the purchase of land—land now in crop or at least recently in crop but not suited for continued crop production. Specific definitions should be established but I would suggest that all land of SCS classes IV and higher, plus all land of better quality but of small parcels isolated by larger areas of poor land, be purchased. Lands of higher physical quality, but of such limited

rainfall as to make cropping unprofitable or too uncertain, might also be purchased. There might well be some difficult problems to resolve in deciding what to buy; a beginning should be made on the obviously poorest lands and on those which the owners were most eager to sell, leaving for later decision marginal cases. No owner would be forced to sell, although some pressures might be brought (as outlined below) and the extent of land purchase would depend in part upon prices offered for land, in part upon weather and price conditions.

The federal government (presumably operating through its Department of Agriculture[4]) would provide loans, and possibly subsidies, to the mixed corporation. It would undertake to re-grass and otherwise improve, within economic limits, the purchased land. While it could not be expected that such improvement would pay its own way, and some considerable subsidy would be necessary, yet there is a limit to the extent to which improvements should be placed on grazing land. Many soil conservation improvements would perhaps be necessary, not only to protect the specific tract against erosion but also for downstream values as well. Some fencing and livestock water development would be necessary for good grazing land management.

When the purchased lands were sufficiently rehabilitated to permit grazing, they should be used for this purpose by livestock owned by private farmers or ranchers in the same locality. Stock ownership and active participation in the mixed corporation might well be a requirement, if individuals were to obtain grazing privileges on the corporation lands. If so, participation in the corporation should be held open until the lands were ready for grazing in order that those individuals skeptical of the operations of the corporation could see that it actually had some grass available.

A mixed corporation of this type should work most closely with existing units of local government, particularly with soil conservation districts and state grazing districts where either exists. Such cooperation should include definition of the areas to be purchased, contacts and information work with land owners, regrassing and other improvement practices on the purchased land, allocation of available grazing, and perhaps even establishment of grazing fees subject to over-all requirements of revenue need. It is conceivable that the mixed corporation would actually seek to operate through such units of local government. But I would argue against this; while full cooperation with local government is highly desirable, operations can be conducted more efficiently and with less danger of favoritism on a state basis. Land purchases would vary greatly from year to year in a locality, depending in large part on weather conditions. Competent appraisal, optioning, development, and management staff could be assembled and kept usefully employed more readily at state than at local levels.

At the same time that subsidies, either direct or in the form of low-interest or interest-free loans, were extended to the mixed corporation some of the subsidies now available to individual farmers might be cut off. For instance, agricultural conservation payments might be denied farmers attempting to grow crops on more than a small (say 5 percent) portion of their land in the classes being bought by the corporation. Price-support loans might also be denied to crops

[4] Proposals for a Great Plains Administration have been advanced in some quarters. Such an Administration, if established, could operate through the corporations here proposed, thus replacing the Department of agriculture as the federal agency. But the two ideas are really independent, and either administration or corporation could be established without reference to the other.

grown on such land. Such financial assistance should not be denied to farmers using better land in the same localities. Such action would bring considerable pressure, financial and otherwise, on those who attempted to crop land unsuited for this purpose. With the data and methods of land classification now available, and with the general acceptance among farmers of land classification, actions of this kind would be administratively feasible today when once they would not have been.

A mixed corporation of this type, owning and managing grazing land, could introduce a large measure of flexibility into the farming of a locality. It should pay some taxes to local government; but such taxes should be relatively low because it would at the same time have considerably lowered the cost of government services in the area. In times of average or favorable weather, it should pay some interest on the loan from the federal government; probably not full interest, because it would be heavily over-capitalized in relation to the productive land value to the extent of the subsidy involved in the re-grassing. In such times it should also lay up some surpluses of cash to pay its taxes and other expenses in periods of severe drouth. In the latter periods grazing use would have to be reduced but the rancher-users of such land would be relieved of the carrying charges for it. When conditions began to improve after a drouth or depression the rancher or farmer would use his limited capital for machinery and livestock purchase, not to gain or maintain control over grazing land. While such a mixed corporation could introduce a considerable degree of flexibility into agricultural operations in a locality, there should be no illusions that this alone would solve all problems of climatic variability in the Great Plains. Individual ranchers and farmers would still have difficult problems of financial and business management and there would still be need for special credit programs, as well as for programs to facilitate other needed adjustments in the area.

A program of this kind would obviously cost the federal government some money, possibly something in the rough magnitude of $200 to $500 million over a period of years. But the past and present programs—or lack of them, if you prefer to describe it this way—have also cost the federal government much money, and the extent of the permanent adjustment is small and there is little reason to expect that further subsidies on a large scale will not be necessary. If money were expended in this way, more permanent results would likely result. If a mixed corporation were to be effective, it should have funds on hand or quickly obtainable to buy and improve lands when weather conditions were favorable.

Mixed corporations of this type would give a large measure of local control over the program. Even their day-to-day administration would be considerably affected by their federal stock ownership and even more by the leadership and stimulus of federal employees. Within defined limits the corporation could manage its own business. At the same time its loans from the federal government would prevent it from taking steps clearly contrary to the purpose of the program. Specifically, it would be forbidden to allow plow-up of its land except in time of national emergency. A corporation which violated the terms of its loans could be foreclosed upon and management be taken over directly by the federal government.

The foregoing is obviously only a rough outline; many details would have to be worked out and they need not be

worked out in exactly the same way in every state. The states should be forced to be more than nominal participants in such a program. The principal idea which this article has intended to convey is that new forms of land management and control are possible; our only alternatives are not speculative and rapidly rotating private ownership on the one hand, or federal ownership on the other. Perhaps still other major variants could be devised.

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Reports and Comments

"Urban Pressures on California Land:" A Comment

PROFESSOR GREGOR'S lucid article[1] calls attention to a significant urban growth process that has often been discussed but seldom analyzed—namely, the transfer of agricultural land to urban use. It is not the purpose of this note to challenge Professor Gregor's basic premise that large amounts of land are being transferred from agricultural to urban uses in California. However, in view of the amount of discussion surrounding this matter, it seems urgently necessary to comment on Professor Gregor's conclusions and particularly the implications of his statements for policy.

Basically, Professor Gregor argues that the diminution of agricultural land as a result of the transfer from agricultural to urban uses is serious in California because of the relatively limited amounts of agricultural land available in the state, and of concern to the nation because the land taken out of agricultural use in California would otherwise be devoted primarily to the growing of specialty crops. The basic factors causing the transfer, according to Professor Gregor, are (1) the rapid population growth in California, (2) the preference of immigrants into the state for urban living, (3) the strong emphasis on the part of the farm population for monetary returns from farming (as opposed to emphasis in other parts of the nation on the amenities of rural life), (4) the penchant of Californians to build out from urban communities rather than to build up within them, (5) the fringe developments well beyond the urban core which affect the surrounding land uses, and finally (6) the urban orientation of land planning.[2]

Urban encroachment on agricultural land is not, of course, a new phenomenon. The problem, if any, is noticeable in California because of the total amount of land which is being transferred in response to the high levels of immigration into the state. For example, over 465,000 persons entered California in 1952 alone and population increase in 1957 is expected to be 570,000[3] and net immigration to be 350,000. Since most of this population increase is centered in the major metropolitan areas—Los Angeles, San Diego and San Francisco—it is not surprising that large amounts of land surrounding these areas are being transferred from rural to urban use.[4]

However, it is important to note, as does Professor Gregor, that in spite of his quoted estimate of 100,000-500,000 acres of land taken out of agricultural use each year, there has been no overall net loss of agricultural land in the state although there has been a decline of certain types of specific uses. Clearly, the 100,000-500,000 acres removed from agricultural use have in the past either been replaced by new land brought into cultivation or there is a lesser loss than Professor Gregor indicates. Actually, both conditions appear to be present. According to a report of the United States Soil Conservation Service for the years 1942-1955, 819,518 acres of cultivable land were converted to nonagricultural use in California—about 63,000 acres per year, and over 70 percent of the land which was transferred was located around the eight metropolitan areas in the state.[5] If it is as-

[1] Howard F. Gregor, "Urban Pressures on California Land," *Land Economics*, November 1957, pp. 311-325.

[2] *Ibid*, pp. 311-314.

[3] *California's Population in 1957*, Department of Finance Budget Division, Financial Research Section, Sacramento, July 1957.

[4] There is evidence, however, that the rate of conversion in California is not extraordinary. Professor Bogue reports in "Metropolitan Growth and the Conversion of Land to Nonagricultural Uses," (*Studies in Population Distribution No. 11*, Miami University and University of Chicago, 1956), that the rate of conversion in the Metropolitan areas of California is about 142 acres of cultivable land per 1,000 population increase. This estimate, prepared from data of the Soil Conservation Service, he finds is comparable to his figures for the nation as a whole "after an adjustment was made for time span and an allowance for the conversion of farm land other than cultivable." This tends to contradict Professor Gregor's suggestion that California is unusual in its rate of conversion.

[5] Cited in "State Greenbelt Legislation and the Problem of Urban Encroachment on California Agriculture," Preliminary Report of the Subcommittee on Planning and Zoning, Assembly Interim Committee on Conservation, *Planning and Public Works*, published by Assembly of the State of California, May 1957.

sumed that no conversions took place during the period of World War II, the amount of yearly conversion is still 20 percent less than the lower estimate quoted by Professor Gregor. Nevertheless, a decline of 80,000 acres per year represents a considerable loss of agricultural land; and, if it were not for the fact that it could be replaced by other land, it would constitute a serious problem.

The most accurate study of California land use indicates that there is currently 16 million acres of cultivable land in California, 10 million of which are in crops, fallow, hay or pasture. In this study it is noted that "over 3 million acres of land suitable for *regular* cultivation (capability Classes I, II, and III) and 2¾ million acres of land suitable for *limited* cultivation in rotation with improved pastures (Class IV land) are now being grazed."[6] Thus, the "crop and improved pasture lands of the state could therefore be increased by about 6 million acres if all the suitable land were developed to its full capability."[7] Furthermore, because of the methodology used in the study, land was classified as not suitable for cultivation where "water for irrigation is not expected to be made available."[8] The indications are that much of the land would be capable of cultivated use but "since an adequate supply of water for irrigating this land is not expected in the foreseeable future, it was classified as unsuitable for cultivated crop production."[9] Over 2,250,000 acres fall into this category; and, while all of this land will not be made available, much of it does have potential use. Using only the 6 million acres which can with assurance be brought into use, California has a sufficient reserve to replace current losses to urban use for sixty years. Clearly, with such a reserve, the present losses cannot be construed as creating any immediate problems with respect to a limitation of the food supply.

Granting that there may be adequate agricultural land in general, is Professor Gregor's concern over loss of specialty land unfounded? There is no question that acreage utilized for the production of specific types of crops has declined but at the same time the yield per acre of agricultural land has increased substantially during the period of transfer. For example, the yield per acre for fruits and nuts in the period 1950-1956 was 5.4 tons per acre compared to 4.1 tons per acre during the period 1937-1941. The yield per acre for oranges was 6 tons before World War II, 8.5 tons per acre during the war, somewhat less in the period 1946-1950, and today it is approximately 7.8 tons per acre.[10] The output of citrus has decreased but the decrease has been offset by the output of other fruits. The situation is well summarized as follows: "During the five-year period, 1942-1946, fruit production climbed to an average of 7,240,000 tons and . . . . there has been no great change in the volume since that time. During this same period, however, the total bearing acreage declined about 18 percent, again reflecting increased yields per acre. With the exception of apricots, avocados, figs, grapes, grapefruits, lemons, and oranges, production in 1956 was above the average of recent years, with new records established for almonds, Bartlett pears, clingstone peaches and olives."[11]

Many factors in addition to land area affect production; and in California it is clear that farmers gear their production policies to the market situation. Fruit and nut production in 1951 was the highest recorded in the post-World War II period, largely because of rapid ton value increases in the latter part of 1950 to $78.25 per ton as compared with $55.00 per ton in 1949. When prices fell in the latter part of 1951, production was cut back until 1954 when prices again rose. In 1955 prices dropped again so production fell in 1956. The significant fact is that fruit and nut producers show great flexibility in their output pattern and adjust their output in the face of price changes. The fact that production is increased substantially when prices warrant indicates that producers respond to the market by raising output when it is profitable to do so. During the period 1951-1954, 28,003,000 tons of fruits and nuts were produced compared to 27,957,000 tons during the period 1947-1950 in spite of the fact that in every year there was a decline in the bearing acreage of these crops. Professor Gregor's alarm at the loss of land and decline of specialty crops, at any rate to this date, appears to be somewhat overextended.

[6] Leonard R. Wohletz and Edward F. Dolder, *Know California's Land* (Sacramento, California: State Printing Office, 1952), p. 8.
[7] *Ibid.*, p. 8.
[8] *Idem.*
[9] *Ibid.*, pp. 17-18.
[10] California Department of Agriculture Bulletin, Vol. XLVI, No. 2, April-May-June 1957, p. 80.
[11] *Ibid.*, p. 79.

There are, of course, certain specific types of citrus production which are declining and Professor Gregor implies that, since California is one of the few areas of the nation where citrus cultivation is possible, public policy of some sort should be introduced to protect this production. However, whenever the price of citrus fruits is attractive enough to yield a return on the land higher than that earned in urban use, such transfers will cease. At the present time, competition from frozen citrus juices, unfavorable prices and competition from other areas have made protective policies unnecessary, unattractive financially and undesirable economically. It is clear that the transfers of land which have taken place have been the result of normal market operations. Consequently, the public is not alarmed about the situation and this is the major reason why Professor Gregor must report that "a large segment of the state's population shows apathy, at best, over the problem of diminishing agricultural land."[12]

The balance of Professor Gregor's comments, implicitly directed to explaining the reasons and results of transfer, are interesting —and indeed alarming. One of the most important reasons encouraging transfer according to Professor Gregor is the great amount of "industrial" agriculture in California. He apparently prefers agriculture to be a "way of life" as much as a vocation. Although one may deplore the highly monetized approach to agriculture apparent in California, it is indeed a fact, and his evaluation that it is unfortunate is irrelevant to the major issue. A blind faith in the rural way of life, unwillingness to encourage migration from farms when prices and /or productivity are low, or to discourage the sale of land when it has some higher use than agriculture may be important factors in limiting productivity, keeping farm income low and preventing a rise in the real standard of living of all members of the economy. Although the pecuniary view of agriculture and the "too narrow view of the value of agricultural land" may be unattractive to Professor Gregor's personal philosophy, it is this view which has contributed to the high standard of living of farm workers in California as evidenced by average farm wages well above those paid in the nation.[13] If such a view could be encouraged in other areas of the United States, perhaps a good part of the national agricultural problem would be solved.

Professor Gregor also challenges the underlying base of the demand function—the desire of consumers—when he condemns the process of building out rather than building up. However, a public policy designed to discourage the single-family home type of construction so prevalent in California would make the free market system meaningless. Much more important in the "building out" process than the "Midwestern" preference for single-family homes has been the relative cheapness of land and the transportation systems which have made commuting to metropolitan areas feasible.

To argue that land is intrinsically useful for one or another use is neither valid nor analytically useful. The reason land around urban areas is being used for homes is because it has more value for *urban than rural uses*. Admittedly, with the Federal Housing Administration program, there has been some indirect subsidization of urbanization in terms of single-family homes but then this has been minute compared with the general subsidization provided agriculture—and subsidization in California particularly—through special irrigation programs and blanket freight rates across the Mississippi. If, as Professor Gregor argues, agricultural land adjacent to urban areas is being discriminated against through taxation, social costs such as damage to crops by smog, children, etc., then the entire economy suffers through higher costs of agricultural production and efforts should be made to solve such problems. However, these efforts should not be such that they encourage the continued use of land for agricultural production if there is some higher and better alternative use of the land as measured by the capitalized value of its earning capacity.

With respect to planning, Professor Gregor runs into the common problem associated with all types of planning—whether urban or rural. He argues that "preference be given to that area which would be least costly to the

[12] Gregor, *op. cit.*, p. 312.

[13] See *Senate of the State of California, Farm Labor in California*, Special Report of the Joint Legislative Committee on Agriculture and Livestock Problems, Sacramento, 1953. According to this report, "average farm wage rates in California were considerably higher than the average paid throughout the United States for this type of work—whether paid per month, per week, per day or per hour; and whether paid with or without board and room, or with house." Wages paid to Mexican Nationals are also considerably above the national average, and it would not be unreasonable to assume that wages here might be lower.

community."[14] Implicit in this concept is the usual one of interpersonal comparisons of welfare and the idea that a particular value judgment will lead to a higher standard of living. It suggests that the community as a whole does not act rationally and that therefore agriculture should be protected.[15] This judgment takes specific form in the suggestion that there should be more hillside building and less residential development in the fertile valleys. However, given current cost patterns, it is cheaper to transfer land from agricultural to urban use than to build in the hills. It is not surprising, therefore, that this pattern of development has taken place.[16] It is not unlikely that a time will come when the costs of land will be so high for agricultural purposes that home building will be discouraged and the land will stay in agricultural use. However, until such a time comes, the type of control that is envisaged whereby certain types of land are simply not permitted to be transferred to urban use implies the creation of a monopolistic situation for the privileged land owner who is permitted to sell in the face of greater demand and this can only lead to a malallocation of resources.

In the present planning, according to Professor Gregor, the problems of "continued high and efficient food production, a firm resource base for important processing and allied industries and the aesthetic values of open spaces are ignored."[17] However, all evidence indicates that the food problem is not vital, even with reference to the foreseeable future; California is now basically a manufacturing state and does not depend upon agriculture as an important base for employment,[18] and decisions with respect to open spaces must be made on their own merits.

Professor Gregor tends to underestimate the forces of the market. After all, prices in a competitive situation, which is the best description of the transfer process of land, reflect the decisions and judgments of the general public acting with freedom. Any program designed to counteract a general decision of the public which has been so positive as the outward expansion in single-family homes in California must be considered with great care.[19] The strong shadows on the horizon, which Professor Gregor fears, are not the consequences of a loss of agricultural land but the possibility of arbitrary removal of the decision-making process of the public as reflected through their actions in the market place.

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[14] Gregor *op. cit.*, p. 324.

[15] *Idem.*

[16] The inference which Professor Gregor draws from the example of one construction company that costs of hillside construction are not formidable obviously requires more study. An opposite point of view argues that ". . . . it has been found that improvement costs rise sharply on slopes over 8 to 10 percent. Heavy grading creates settlement and erosion problems." *The Community Builders Handbook*, Urban Land Institute, Washington, 1954, pp. 18-20.

[17] Gregor, *op. cit.*, p. 312.

[18] Agriculture, Forestry and Fishery employment showed only a 54.6 percent increase between 1940 and 1956 as against a 170.3 percent increase for manufacturing. Apart from mineral extraction where employment declined between the two bench-mark years, the former showed the smallest percentage increase in employment for all industry divisions. See *Handbook of California Labor Statistics, 1955-1956*, Department of Industrial Relations, Division of Labor Statistics and Research, San Francisco, 1957.

[19] This does not mean that planning and zoning are unnecessary. However, planning can only provide a framework within which decisions can be made, and it cannot operate effectively if it runs counter to the trends and desires of the majority of the people. For a case in point of the collapse of planning when it was opposed to economic forces and majority wishes, see Fred Case and James Gillies, "Land Planning in Rapidly Developing Areas: The San Fernando Valley Case," *The Appraisal Journal*, January 1954.

"Urban Pressures on California Land:" A Rejoinder

PROFESSORS Gillies and Mittelbach present a viewpoint which is still strong in California concerning the increasing rural-urban competition for land, i.e., that little cropland has actually been lost in relation to a large reservoir of arable land still available, that technology will further compensate for any such losses, that freely operating marketing processes will provide the ultimate insurance against cropland diminution—if the market deems it the most appropriate land use, and that therefore restrictions on the forces of the market (e.g., "greenbelt" zoning) tend to do more harm than good for the general welfare. Such opinions, so diametrically opposed to those of mine as ex-

pressed in the article under discussion,[1] deserve immediate comment, if for no other reason than to emphasize my contention that California agricultural land *is* being lost in ever-increasing amounts, and that such losses portend serious results for both California and the nation if more and intelligent planning is not done and soon.

Statistics which Professors Gillies and Mittelbach present to show that the rate of rural-urban land transfer is much less than my quotations and that abundant amounts of potential cropland remain, should be strongly qualified. My estimated annual loss of cropland of 100,000-500,000 acres applies only to the years 1954-1956. The ten-year average of an annual 80,000 acres cited by the two authors is one which ignores the fact that population—and therefore land demands—in California has been increasing at an increasing rate, particularly since 1950.[2] Also ignored is my rather full treatment of the spatial patterns of urban expansion which shows that the *future* rate of agricultural land loss is even more significant in that it is continuing to grow at a faster pace than the population increase rate.[3] The 6,000,000 acres of potential cropland which Professors Gillies and Mittelbach extract from Wohletz and Dolder[4] is strongly leavened by the latter themselves. Of the 3,000,000 acres in capability classes I, II, and III, only 52,270 (Class I) are deemed to have no limitations in use. The remainder is beset with increasing limitations. Class II (1,114,480 acres) requires such additional land use measures as strip and contour cropping in more sloping areas and drainage systems where necessary. Further, the range of crops becomes more restricted and irrigation becomes less efficient where such soil conditions as shallowness, sandiness, salinity, and clayey surface textures exist. All of these conditions are more serious in the even larger Class III soil group (1,992,320 acres). And, as Professors Gillies and Mittelbach note, the remaining 2,750,000 acres of the 6,000,000 are suitable for only limited cultivation because of even greater handicaps. An additional 2,250,000 acres are listed by them as having some potential use but which are not to be used in the near future because of insufficient water supply. Actually such insufficiency is two-fold: competition for water with other agricultural areas; and the increasing inability of agricultural districts to obtain sufficient capital to pay for growing water and irrigation development costs in competition with the wealthier urban areas.

This "reservoir" of 6,000,000 acres (or even 8,000,000, if the above-mentioned 2,250,000 acres are included) becomes even more questionable when it is observed that the greatest amount and rate of urbanization is taking place on the most fertile acres—again described in my article. If, in addition, we accept Wendt's quoted national average of 3.3 persons per household (higher than recent California experience),[5] Solberg's 1.4 acres of living, transportation, and working space for urban people and farmers (not including farms),[6] and a 17.8 million population estimate for California in 1965 based on the present rate of increase,[7] it will be seen that two-thirds of the best 3,000,000 acres available for future irrigation farming will have been taken for urban purposes by 1965. If the current population expansion rate is extrapolated to 1975, practically all of the 8,000,000 acres of available, or partially available, land will then have been absorbed by urban use.[8] These highly probable losses become additionally eloquent when viewed in the light of the rapid national population increase and changing dietary demands, factors contributing to an expanding rate of increase in food demands. Pre-World War II demographic predictions of a continuing decline in the birth rate not only have been discredited, but more recent estimates of population growth have been revised upward as well. The latest projection for 1975 indicates a population of 199 to 221 million, appreci-

[1] Howard F. Gregor, "Urban Pressures on California Land," *Land Economics*, November 1957, pp. 311-25.

[2] The population increase rate for Santa Clara County in the San Francisco Bay Area, for example, was 5.8 percent for the 1945-52 period and 8.5 percent for the 1953-56 span. In 1956, it rose to 12.1 percent, the highest in the nine-county Bay Area. *San Jose Mercury-News*, January 19, 1958, p. 2P.

[3] Gregor, *op. cit.*, pp. 317-18.

[4] Leonard R. Wohletz and Edward F. Dolder, *Know California's Land* (Sacramento: State Printing Office, 1952), pp. 10-13.

[5] Paul F. Wendt, "Estimating California's Housing Demand, 1954 to 1965," *The Appraisal Journal*, October 1954, pp. 564-69.

[6] Erling D. Solberg, "Cities and Farms, Side by Side," paper read at the Southern California Planning Institute Los Angeles, June 17-18, 1955, p. 7. (mimeographed)

[7] U. S. Bureau of the Census, *Current Population Reports Population Estimates*, Series P-25, no. 110 (Washington: Government Printing Office, February 20, 1955),

[8] Karl Belser, "The Conservation of Agricultural Land," 1955, p. 2. (mimeographed.)

ably higher than earlier estimates for that year.[9] As to diet: "The proportion of grain products and potatoes has declined about a third, while the proportion of livestock products has risen slightly, and that of miscellaneous products—mainly fruits and vegetables—has gone up about 50 percent."[10] Thus, per capita acreage demands are increasing despite decreasing consumption of calories and numbers of horses and mules to be fed.[11] Fruits and vegetables are, of course, the principal contribution of the California agricultural economy to the nation. In light of these and previously-mentioned increasing claims on California agricultural land, it is indeed difficult to comprehend Professors Gillies' and Mittelbach's statement: ". . . . all evidence indicates that the food problem is not vital, even with reference to the foreseeable future."

Professors Gillies and Mittelbach assure us that other hedges against serious loss of California cropland are available: *Agricultural technology* and *market forces*. Both are cogent arguments but, like the present amount of land available for future cropping, must be at least partially questioned with regard to the possible future. Increasing yields have indeed compensated until now for urbanization inroads on overall state agricultural production. But this does not remove the fact that increasing urbanization is steadily forcing the agricultural industry onto poorer lands, with their poorer soils, their more unfavorable terrain for both cultivation and irrigation, and their scantier water supply. Highest yields are now obtained on areas which are both nearest the city margins and on the most favorable lands for agriculture in the state. And, as pointed out earlier, these lands are diminishing faster than the poorer areas.[12] Will yields on the poorer soils ever be as high as those on the current good soils? So far, the answer is doubtful, not only from the standpoint of technological expansion but concerning the continuing and growing availability of such improvements to the farmer. It is well known that this availability is strongly conditioned by not only the number of agricultural discoveries but the degree of growth and the level of national prosperity. Also, it is the general opinion of pedologists that there is a definite physical limit to the productive capabilities of a soil, no matter how intensive their utilization. There is presently no question, however, with regard to many of California's specialty crops which can be raised only in certain localized areas because of certain strict physical requirements for growth: New agricultural techniques have made little progress in furthering the economic growth of such crops as lemons, avocadoes, apricots, and figs in other parts of the country and even in many arable lands within California.[13] Would Professors Gillies and Mittelbach call "special irrigation programs and blanket freight rates across the Mississippi" for such products "[uneconomic] subsidization" insofar as the national economy and health are concerned?

That such specialty crops will eventually disappear from the California scene is unlikely, according to Professors Gillies and Mittelbach, since by then prices for such land would have become high enough to discourage further urban encroachment. In theory, such a "solution" seems unassailable. Actually, there is no guarantee of such an outcome since such a claim assigns an extraordinary depth of technical information and related analysis —as well as an almost infallible intuition— to most of the speculators and imputes an omniscience to a pricing mechanism which fails to recognize external economies and diseconomies. Extensive examples abound, both in the United States and without, of where speculators failed to recognize the true economic limits to utilization of a resource, thereby through its exhaustion

[9] U. S. Bureau of the Census, *op. cit.*, no. 78 (Washington: Government Printing Office, April 21, 1953).

[10] The President's Water Resources Policy Commission, *A Water Policy for the American People*, Vol. I (Washington: Government Printing Office, 1950), p. 156.

[11] George E. Goodall and Robert C. Rock, "Approaches to Land Use Planning," *The California Citrograph*, April 1955, p. 206.

[12] Thus, in Los Angeles County, although crop yields have reached record levels, total crop tonnage has been declining steadily since at least 1948. Los Angeles County Chamber of Commerce, *Supplement: Crop Acreage Trends for Los Angeles County and Southern California* (Los Angeles: Los Angeles County Board of Supervisors, 1956), p. 5.

[13] Professor Gillies and Mittelbach indirectly admit th growing problem of increasing the production of "natural monopoly" crops in the face of urbanization of cropland when they note that "with the exception of apricots, avocados, figs, grapes, grapefruit, lemons, and oranges, production in 1956 was above the average of recent years. . . . ." Weeks further warns that the increasing age of California orchards will in the very near future cause decreasing yields to pair with already decreasing bearing acreage so as to further hasten the general fall in production. David Weeks, "A Preliminary Projection of California Crop Patterns for Estimating Ultimate Water Requirements," *Water Utilization and Requirements of California*, Bull. No. 2 of the [California] State Water Resources Board, Appendix A (Sacramento: State Printing Office, 1955), p. 250.

bringing general economic collapse to a region: the general deforestation of Norway Pine in the Upper Lakes Region; the systematic devastation of soils in southeastern United States through extensive monoculture and clean cultivation on strongly sloping lands; the almost complete removal of the forests in the Mediterranean area; the permanent destruction of the productive capacity of thousands of acres of grassland soils in such areas as the Great Plains, China, and South Africa. In all of these instances, too great a degree of faith in technology and the availability of a future reserve played a principal part in the operations of the speculator. In California today it is imperative the speculator recognize that stage at which no further urbanization of heavy-producing agricultural lands is feasible, but can he?[14] He can operate only by price; and the pricing mechanism *by itself* ignores such important factors as the external economies of California agriculture and the external diseconomies of urbanization and industrialization of cropland.

Prominent in the external economies of agriculture in California is the canning industry which, despite the overall industrial character of the state's population, is second only to the aircraft industry in number of people employed.[15] Another benefit of California agriculture, not widely recognized, lies in the abundant, year-around supplies of food in close proximity to metropolitan centers and their resultant lowering of living costs. This has been an important item to many eastern firms when considering installation of a plant in California.[16] The external diseconomies of urbanization and industrialization of cropland, such as loss of agricultural specialty lands, growing air pollution, proliferation of "block tracts" and "ribbon business districts," and compaction of land, are obviously far-reaching in both economic and social effects. Apparently Professors Gillies and Mittelbach reject the possibility that, whenever there are significant external economies or diseconomies, the market place may lead away from the economic and social optima rather than toward them. As the gap between world populations and natural resources has narrowed, increasing attention has been accorded regulatory activities which can eliminate, or minimize, such a divergence.[17]

Professors Gillies and Mittelbach do raise a reasonable question about the equity of a type of control that would permit some land to be used for profitable industrial or residential purposes while keeping other land holders from taking full advantage of their properties. To avoid this inequity and to protect zoning laws against powerful political pressure, a subsidy is probably in order. The present California greenbelt program under which specific agricultural land is assessed and hence taxed at preferential rates has this effect. Of course, developed land will pay taxes even higher than it normally does as a result; but is this an unfair price for such advantages as the saving of some of the better California soils for increased food demands of the future or the preservation of some open spaces for the enjoyment of which the urban dweller seems willing to endure commuting discomforts and pay premium land prices? Such a program also does not envisage a *permanent* restriction of land to agricultural use but merely provides more time to consider the best possible future use of the area concerned, as I have emphasized in my article.[18] The subsidization of industries with important external economies and the taxing of industries with external diseconomies is a traditional remedy recommended by even the neo-classical economists for distortions of the unregulated market place.[19] Professors Gillies and Mittelbach seemingly refuse to admit the

[14] A detailed description of the "Hindrances to Equality of Returns Due to Imperfect Knowledge" of the speculator in general is provided by A. C. Pigou, *The Economics of Welfare*. (London: MacMillan and Co., Limited, 1950), Chapter VI, pp. 149-66.

[15] The significance of the agricultural processing industry in California, a much bigger part of the state's economy than for the nation as a whole, is slighted in Professor Gillies' and Mittelbach's footnote 18. They are correct, of course, as to which industries are growing fastest but that is my main point of argument (i.e., urbanization of agricultural land).

[16] Los Angeles County Chamber of Commerce, *1925-1954 Crop Acreage Trends for Los Angeles County and Southern California*. (Los Angeles: Los Angeles County Board of Supervisors, 1955), p. 10.

[17] Cf. especially Chapter IX, "Divergences Between Marginal Social Net Product and Marginal Private Net Product," of Pigou, *op. cit.*, pp. 172-203.

[18] The "garden cities" to which Professors F. E. Case and Gillies refer as an example of too rigid a restriction on land use ("Some Aspects of Land Planning—The San Fernando Valley Case," *The Appraisal Journal*, January, 1955, pp. 14-41.) are therefore quite different in concept from that of the greenbelts. The fault of the "garden city" idea in California is that it presupposes a more or less static population. G. S. Wehrwein, "The Rural-Urban Fringe," *Economic Geography*, July 1942, p. 219.

[19] Besides Pigou, *op. cit.*, cf. also the writings of such economists as Marshall and Stigler.

possibility of progress toward social direction of land use while preserving the essential aspect of a free private market. They evidently would have us believe that measures adopted toward gaining that goal represent an "arbitrary removal of the decision-making process of the public as reflected through their actions in the market place."

Such regulatory proceedings also, according to them, "suggest that the community as a whole does not act rationally . . . ." Presumably, "rationally" refers here only to community actions based solely on market prices, some inadequacies of which I have already noted. Such statements also seem to imply that these controls are superimposed on the community from "above." It is generally agreed that planning, whether in the governmental or "planning commission" sense, is only as good as the wishes of the people involved. The development of effective planning programs has thus been in direct ratio to the growing public awareness of the larger problems (e.g., rural-urban land transfer in California) which affect the entire community, state, and nation. Some of the obstacles to such an appreciation have been: the false concept that natural resources and technological advancements are endless; a conviction that the only important problems are those which affect the individual most immediately and directly; the lack of financial compensation for any personal effort on a problem that does not reflect itself fairly immediately in the marketing mechanism; and a natural inertia toward making oneself effectively heard on important issues. Education, both planned and incidental, is making good progress on these issues, but much remains to be done. A generally uninformed public offers no more solution to the agricultural land loss problem in California than the unregulated devices of a "free" market.

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Notes on Railroad Productivity and Efficiency Measures†

ECONOMISTS have shown considerable interest in the measurement of productivity and efficiency.[1] In this paper our interest centers on some productivity and efficiency measures currently used in the railroad industry.[2] For many years these measures have been used to gauge the performance of freight yards, sectors of a railroad, and entire railroads; but despite their importance and widespread use there seems to have been little systematic study of their adequacy. In particular, the purpose of this paper is to call attention to some difficulties in these measures and to suggest some relatively simple means of improving them. Since regulatory bodies and research workers sometimes rely on them, an evaluation of these measures should be useful. Moreover, a study of information generated within a firm, even if it applies to only one type of information in one industry, should be of some interest to economists in general.

I. Freight Yards

The productivity and efficiency measures discussed here refer basically to freight yards. Those corresponding to sectors of a railroad or a whole railroad are merely aggregates of the measures for individual freight yards. We confine our attention largely to the adequacy of these measures at the freight yard level but the results should apply, at least generally, to the aggregate measures as well. Since the measures refer to freight yards, it may be well to describe the latter.

† This research is part of a larger project dealing with the railroad industry. The project was supported by a grant from the Westinghouse Air Brake Corporation to Carnegie Institute of Technology. The authors acknowledge the valuable assistance of C. Link, R. Nadel, and E. Saunders of the cooperating railroad, and the comments of our colleagues, D. Chambers, C. Haberstroh, and J. Walter, on an earlier draft.

[1] E.g., T. Barna, "Note on the Productivity of Labour: Its Concept and Measurement," *Bulletin of the Oxford Institute of Statistics*, July 1946; W. Evans and I. Siegel, "The Meaning of Productivity Indexes," *Journal of the American Statistical Association*, March 1942; and S. Harris, J. Davis, T. Hitch, C. Kerr, and S. Fabricant, "Productivity and Wages," *Review of Economics and Statistics*, November 1949.

[2] The purpose of this paper is not to debate the usefulness of average productivity or efficiency measures. Much has already been written on these subjects: e.g., F. Jasinsky, "Use and Misuse of Efficiency Control," *Harvard Business Review*, August 1956; L. Maverick, *Productivity*, Carbondale, Illinois, and the literature cited there.

Physical Characteristics. All yards contain sets of tracks. In large yards they are generally of three types: receiving tracks where incoming freight cars are stored, classification tracks where cars are switched, and outbound tracks where cars that were situated on a classification track are stored until a locomotive hauls them away as a train.

Functions. Freight yards switch cars. That is, they sort incoming cars by putting them on the appropriate classification tracks and in doing so they break up incoming trains to form new trains. Most yards also deliver and pick up cars. Engines are assigned to deliver cars to industrial sidings and other yards and to pick them up there. Finally, many yards bill and inspect cars and perform such ancillary services as maintenance, repair, and storage.[3]

A large railroad may have 200 or more yards. For the firm we studied, the operation of these yards accounted for about one-third of total operating costs.

II. Output Measures

To measure productivity or efficiency, some measure of output is needed. The railroads use the number of cars handled, i.e., the number of cars that leave a yard on outgoing trains during a particular period, as a measure of freight yard output.[4] Even at first glance the adequacy of this measure seems rather questionable. The following factors suggest that the number of cars that *leave* a yard during some period may not measure very adequately the number of cars *serviced* or the amount of servicing done during the period. (1) The number of cars that leave a yard includes many trains that merely stop there to change crews. The cars on these trains are serviced in only a limited sense and there seems to be little justification for including them in yard output.[5] (2) The number of cars handled gives each car that leaves a yard an equal weight in determining output. But some of these cars were only switched, whereas others were switched, delivered to a customer, returned to the yard, and switched again. (3) For short periods, the number of cars handled may be misleading because many cars that leave a yard in one period were serviced in a preceding one.

In view of these factors, two questions arise. Can an output measure be devised that is relatively free of these defects? If so, is this alternative measure so highly correlated with the number of cars handled that one may be used in lieu of the other, or is the correlation so low that quite different conclusions might result from the use of different measures? The answers to these questions are of importance in our subsequent discussion of productivity and efficiency measures.

First, consider the problem of devising a better measure. Two obvious improvements might be to omit from the output measure those cars that have not actually been serviced and to credit output to the period when it was "produced." Having made these changes, the difficulties in measuring output arise because a yard performs several, non-homogeneous services. Probably the two most important services that should be distinguished are switching and delivering: they are quite distinct and require different amounts of engine and crew time. From this distinction and the two previous changes it would seem that a better output measure might be the number of cars switched and the number of cars delivered during a particular period.[6] Of course, this measure conceals considerable heterogeneity. For example, two groups of cars may be delivered but one group may have to be hauled a greater distance than the other. Some of this heterogeneity could be eliminated by the use of further distinctions in the output measure but these improvements would result in more complexity with regard to data collection and interpretation of the results.

[3] For a more complete description of yard operations, see M. Beckmann, C. McGuire, and C. Winsten, *Studies in the Economics of Transportation*, (New Haven, Connecticut: Yale University Press, 1956).

[4] Some railroads include in the number of cars handled both the cars that leave the yard and those that enter it.

[5] The work performed on those trains consists primarily of switching the caboose. Admittedly, an engine must be ready to perform this service quickly and it must sometimes wait if the train is not on schedule. But, as a first approximation, it seems reasonable to omit these trains from yard output.

[6] An alternative measure might be the number of cuts switched and the number of cars delivered. See our "A Regression Control Chart for Costs," *Applied Statistics*, forthcoming; "A Model for the Location of a Railroad Classification Yard," *Management Science*, forthcoming; and "A Study of Decision-Making Within the Firm," (multilithed).

It might be noted that the cost of computing the output measure proposed above (and other measures proposed subsequently) should not be significantly greater than that of computing the measure presently used. At first, a cost differential might exist because the yard records are not designed to yield the basic data that are required but this differential would decrease over time.

Second, consider the question regarding the correlation between the number of cars handled and the alternative output measure. To determine whether the correlation is in fact high it is necessary to combine the number of cars switched and the number of cars delivered into a single figure. Unfortunately, no available set of weights seems satisfactory.[7] To circumvent this difficulty, we shall find the *maximum* correlation coefficient between the number of cars handled and *any* linear combination of the number of cars switched and the number of cars delivered.[8] Data were collected at two large freight yards for a 61-day period.[9] One of these yards was a large flat yard; the other was a large hump yard.[10] The maximum correlation coefficient betwen (1) the number of cars handled each day and (2) any linear combination of the number of cars switched and the number of cars delivered each day was .4 at the flat yard and .5 at the hump yard. To make sure that the low correlation was not due to the short time intervals used, the data were aggregated into weekly observations. The maximum correlation coefficients were .2 and .4. These results certainly suggest that the two measures are *not* so highly correlated that one may be used in lieu of the other.[11]

III. Productivity Measures

In freight yards the bulk of the work is performed with locomotives and hence the productivity measure refers to engine productivity. The measure most commonly used is the number of cars handled per engine hour. This figure is computed daily, monthly, and annually for each freight yard and comparisons are made over time to determine changes in average productivity.[12] Note that the number of cars handled is used in this measure as an index of output. Some doubt has been expressed concerning the adequacy of this index and hence there must also be doubt concerning the adequacy of the number of cars handled per engine hour as a productivity index.

It would appear that a more adequate productivity index might result if the alternative output measure proposed above were used. One such productivity index is shown on next page. It is formally identical with an index number used by the Bureau of Labor Statistics.[13]

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[7] To combine the number of cars switched and the number of cars delivered into a single index of output, some set of weights is necessary. Ordinarily, the prices of the services would be used as weights, but no such prices exist here. Other types of weights might conceivably be used but little data are available and it is difficult even in principle to construct a set of weights that is entirely satisfactory.

[8] The maximum correlation coefficient between the number of cars handled and any linear combination of the number of cars switched and the number of cars delivered is, of course, the multiple correlation coefficient between the number of cars handled and the other two variables. See H. Cramer, *Mathematical Methods of Statistics*, (Princeton New Jersey: Princeton University Press, 1946), 307-8. The consideration of only linear combinations of the number of cars switched and the number of cars delivered does not seem very restrictive.

[9] The number of cars handled each day was readily available at each yard. The number of cars switched each day was determined by adding the number of cars on receiving tracks at the beginning of the day to the number of cars that arrived to be switched during the day and by subtracting from the result the number of cars on receiving tracks at the end of the day. The number of cars delivered each day was determined from the "puller sheets" at the yards; it included the cars picked up from sidings and other yards as well as those delivered.

[10] Freight yards may be divided roughly into two types, flat yards and hump yards. Switching is done differently in a flat yard than in a hump yard.

[11] The correlation coefficient measures only the strength of a linear relationship. But the maximum correlation coefficients shown above are so small that it is doubtful that any simple type of direct relationship would be very strong.

[12] For larger segments of a railroad, the number of cars handled per engine hour is also used as a productivity measure. In this case the number of cars handled is the sum of the cars handled at each of the yards in the segment and the number of engine hours is also the sum for all the yards in the segment.

We, too, are concerned primarily with comparisons over time rather than with the comparison of various freight yards and sectors of a railroad at a point in time. For the latter type of comparison, the heterogeneity in the output measure is probably more important than in the former type.

Note too that changes in productivity may not be attributable to the crews. For example, average productivity may be low because the yard management over-estimated the traffic volume and ordered too many crews, the result being that some crews are idle during part of the day.

[13] See Evans and Siegel, *op. cit.* This index number assumes implicitly that the number of engine hours is a linear, homogeneous function of the number of cars switched and the number of cars delivered. This seems to be a reasonable first approximation, particularly since the yards (at least that we studied) seldom operate at capacity and since there is little or no interaction between the engine requirements per car switched and the number of cars delivered or vice versa. Some discontinuities are ignored, but they are probably of fairly minor importance in large yards. Note too that productivity indexes for very short periods are sometimes of less interest than those for longer ones.

$$P_i = \frac{a_o S_i + b_o D_i}{a_i S_i + b_i D_i}$$

where P_i = index of engine productivity for the ith period,

a_o = number of switch-engine hours per car switched in the base period,

a_i = number of switch-engine hours per car switched in the ith period,

b_o = number of delivery-engine hours per car delivered in the base period,

b_i = number of delivery-engine hours per car delivered in the ith period,

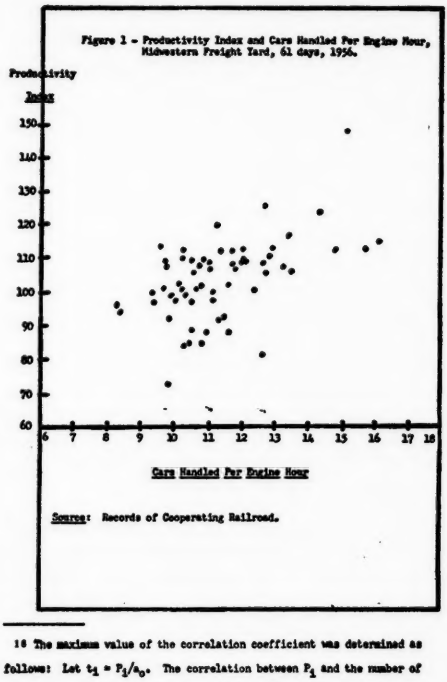
S_i = number of cars switched in the ith period,

D_i = number of cars delivered in the ith period.

Of course, a question arises concerning the correlation between the proposed productivity index and the number of cars handled per engine hour. If this correlation were very high, it would probably be pointless to substitute the one measure for the other. If it were quite low and if the proposed index were accepted as a better measure, some serious doubt would be cast on the adequacy of the number of cars handled per engine hour. To estimate this correlation, data for 61 consecutive days were collected at two freight yards. At one yard the number of cars handled per engine hour and P_i were computed for each day, the two variables were correlated,[14] and the correlation coefficient equalled .5. The data were then aggregated to form weekly observations and the correlation coefficient equalled .3.[15] At the other yard, suitable values of a_0 and b_0 could not be obtained. Without these values, it was possible to derive the correlation coefficient as a function of b_0/a_0 and to determine the maximum value of the coefficient over a reasonable range of b_0/a_0.[16] This maximum value was .2. When the data were aggregated to form weekly observations the maximum value of the coefficient increased to .7.

These results suggest that the correlation is generally quite *low*. To illustrate this, the number of cars handled per engine hour and P_i are plotted in a scatter diagram (Figure 1).

Figure 1 - Productivity Index and Cars Handled Per Engine Hour, Midwestern Freight Yard, 61 days, 1956.



Source: Records of Cooperating Railroad.

[14] The values of a_0 and b_0 were determined by using the first week of the two-month period as the base period.

[15] Of course, it may be objected that the rank correlation coefficient is a better measure here. But it too is quite low. For daily observations it is .5; for weekly observations, .2. Note that the objections to the correlation of ratios do not seem to apply here because the ratios themselves are the observations in which we are directly interested.

[16] The maximum value of the correlation coefficient was determined as follows: Let $t_i = P_i/a_0$. The correlation between P_i and the number of cars handled per engine hour in the i^{th} period (C_i) equals that between t_i and C_i. Now $t_i = x_i + \lambda y_i$, where $x_i = S_i/Z_i$, $y_i = D_i/Z_i$, $\lambda = b_0/a_0$, and $Z_i = a_i S_i + b_i D_i$.

The correlation coefficient between t_i and C_i is

$$\rho_{tc} = \frac{\sigma_{tc}}{\sigma_t \sigma_c} = \frac{\sigma_{xc} + \lambda \sigma_{yc}}{\sigma_c \sqrt{\sigma_x^2 + \lambda^2 \sigma_y^2 + 2\lambda \sigma_{yx}}}, \quad (1)$$

where σ_{tc} is the covariance between t_i and C_i, σ_t is the standard deviation of t_i, etc. Setting $\frac{\partial \rho_{tc}}{\partial \lambda} = 0$,

$$\lambda^* = \frac{\sigma_{xc}\sigma_{yx} - \sigma_{yc}\sigma_x^2}{\sigma_{yx}\sigma_{yc} - \sigma_{xc}\sigma_y^2}.$$

If the second-order conditions hold, the maximum value of ρ to say be obtained by inserting λ^* into (1). The variances and covariances in the expression for λ^* are known for the 61-day period. To be reasonable, it seemed that λ should be between one and ten. If λ^* fell outside that interval, the maximum value of ρ to for $1 \leq \lambda \leq 10$ was used. This was determined graphically.

These data refer to the yard where complete information was available. If the number of cars handled per engine hour and Pi are both plotted against time, one finds that the peaks and troughs often occur at different times in one series than in the other and that the direction of change often differs.

IV. Efficiency Measures

The efficiency measure most commonly used by the railroads is cost per car handled. This is essentially a measure of unit variable cost, but not all variable costs are included. The most important omissions are fuel, inspection, and oiling costs. It will be noted that the number of cars handled is used once more as a measure of output. Efficiency is defined by economists as the ratio of the minimum cost at which a particular output can be produced to the actual cost incurred; engineers are likely to define efficiency as the ratio of some standard cost to the actual cost incurred. Regardless of the definition used, it seems clear that the use of cost per car handled as an efficiency measure rests on several questionable assumptions and that one of them is that the number of cars handled is an adequate measure of output. Again, it would appear that a more adequate measure might result if the output measure proposed above were used in place of the number of cars handled.

Such a measure might be developed in this way: Output might be defined as the number of cars switched and the number of cars delivered. Railroad engineers might then formulate a schedule of standard (or minimum) costs for a yard, each value on the schedule corresponding to a different output level, i.e., a different number of cars switched and number of cars delivered. The efficiency of the yard in any period might be measured by the ratio of the scheduled cost of the output to the actual cost incurred. This measure would reflect the approximations in the schedule, but it might well be a more serviceable measure than cost per car handled.[17]

The following rough test was conducted in two freight yards to determine the extent to which cost per car handled was associated with efficiency when the proposed output measure was used in place of the number of cars handled. Several groups of days were chosen at each yard, the number of cars delivered and the number of cars switched being approximately the same within each group. Since the output levels were about equal on each day in the same group, the higher the costs were on a particular day, the lower was the efficiency of the yard on that day relative to other days in the group. In each group every day was ranked in this way by its efficiency; it was also ranked by its cost per car handled, and the coefficient of rank correlation was computed. At each yard the values of the coefficient varied from group to group, but the average values at the two yards were .6 and −.05. Hence, if the proposed output measure is accepted, it appears that the cost per car handled is *not* very closely associated with efficiency.[18]

V. Conclusion

The results seem to indicate that the productivity and efficiency measures currently used by the railroads suffer from serious shortcomings. Because the output measure used is rough at best, these other measures are also very crude. Of course, the alternative output measure we propose is not ideal and it is not the only one that could have been proposed. Had another alternative output measure been chosen, the current measures might appear somewhat more adequate but it seems likely that the results would not have been altered greatly.[19]

In view of the results, research workers might be well advised to treat these measures with caution and the industry might consider the profitability of substituting other measures for them. Of course, whether these measures are satisfactory depends on what one wishes to do with them. But with regard to industrial uses there is considerable evidence that they are inadequate.

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[17] Both the present efficiency measure and the alternative measure are intended to measure efficiency in terms of the money cost that is incurred in the production of a given output. Neither of them measures the efficiency of a yard in terms of another important dimension, time. An efficiency measure could probably be devised that would take account of the time that cars were delayed in the yard as well as of the money cost incurred but we have not set ourselves that task here.

Note, too, that both the present efficiency measure and the the alternative measure are affected by changes in factor prices. In the alternative measure it would be quite feasible to change the scheduled costs in accordance with major changes in factor prices.

[18] Of course, this test suffers from the fact that the differences in efficiency within the groups may be quite small.

[19] Because of the costliness of procuring data, the investigation was confined to a small number of yards. This factor also limits the results.

A Note on Price Discrimination

"A Reexamination of Discriminatory Price Practices" by Robert L. Winestone and Arthur A. Wichmann,[1] requires comment. The authors examine the case for price discrimination by a decreasing cost firm, find it wanting, and therefore conclude that average cost pricing is preferable.

The issues can best be discussed in terms of the twin economic objectives, efficiency and equity. As defined by the welfare economics on which Professors Winestone and Wichmann draw, an economic position is efficient if there is no possible change which will make at least one person better off and no-one worse off. If we assume, as the authors do, that demand and cost curves are a satisfactory representation of social benefits and costs, efficiency requires that a product (or service) be supplied to every person willing to pay a price at least equal to the marginal cost of supplying it, and that it be denied to anyone whose valuation of it is less than marginal cost. In terms of demand and cost curves, given the usual definitions of those functions, efficiency requires production to the point at which the demand curve intersects the marginal cost curve.

Efficiency is concerned with output, not with price. But since consumers decide on the basis of prices whether, and how much, to purchase, we can state the pricing conditions which will induce the efficient rate of sales: (1) no person shall be charged a price below marginal cost; (2) no person shall be quoted a price, for any unit of consumption, higher than he is willing to pay for that unit. (The second condition is subject to the first.) Prices may exceed marginal cost if they do not cause a reduction in consumption.

Definitions of equity vary significantly, and whether a given price structure is considered equitable depends on the personal standards of the evaluator. By usual standards, however, equity to producers is satisfied if they receive revenues equal to their total costs. Equity to consumers is more complex, but we can perhaps agree, for present purposes, that prices are fair to consumers if (1) the total revenue paid does not exceed total cost, and (2) no customer is charged more than the average cost which would obtain if there were no discrimination. Using these criteria of efficiency and equity, with which professors Winestone and Wichmann would appear to agree, we can evaluate discriminatory and non-discriminatory pricing.

Average cost pricing, without discrimination, satisfies the equity criteria, but not efficiency, since it refuses service to all customers who, while unwilling (or unable) to pay average cost, would still pay enough to cover marginal cost. Efficiency requires that these customers be served. And price discrimination is commonly suggested to tap this added market.

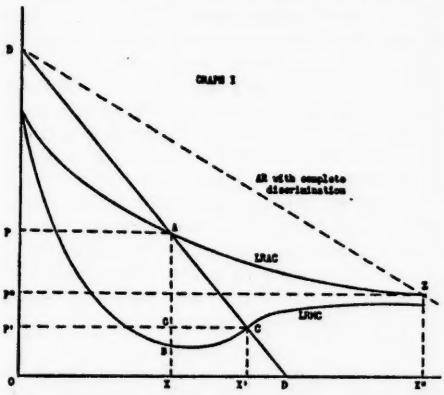
In discussing two-price discrimination, Professors Winestone and Wichmann assume that consumers are divided into two classes, the "non-favored" group which is charged a price equal to average cost, and the "favored" group which is charged marginal cost. If we assume perfect classification, i.e., that the non-favored group includes no one willing to buy more at marginal cost than at average cost and that the favored group includes no one willing to pay average cost, the results in the two-price case conform to our criteria of efficiency and equity if marginal cost is either constant or increasing, but not if marginal cost is decreasing. In the last case total revenues will fall short of total costs, thus conflicting with equity criteria. The solution here lies with three or more prices, discussed below.

Professors Winestone and Wichmann go in search of the "surplus" which price discrimination is alleged to provide. They choose to interpret this surplus as revenues from favored customers in excess of the cost of supplying that group, which can be used to reduce the price to the non-favored consumers (e.g., area BCG in Graph I). They imply that the case for price discrimination stands or falls on this point and consider that case virtually demolished when they point out that only if marginal cost is increasing is there any chance for a surplus.

But the surplus which price discrimination provides is not the one Professors Winestone and Wichmann discuss. The real "surplus" from price discrimination consists of the net addition to satisfaction caused by expanding output beyond that which average cost pricing would provide. It is the difference between what the added consumers would pay for the product (as shown by the demand curve) whether or not they in fact pay

[1] *Land Economics*, May 1957, pp. 149-153. Page numbers in parentheses in this note refer to this article.

it, and the costs of supplying them (measured by the marginal cost curve). Geometrically it is represented by area ABC in Graph I. This surplus exists if output is



expanded to the point at which the demand curve (which shows marginal satisfaction) intersects the marginal cost curve, whatever the pricing pattern, and whether marginal cost for this added consumption is increasing, decreasing, or constant.[2]

The division of this surplus between favored and non-favored groups depends on the specific pricing policy followed and is a matter of equity, not efficiency, so long as the efficiency rules of pricing are satisfied. If the favored group is asked to provide only enough revenues to cover the extra costs for which they are responsible, all the benefit of the surplus accrues to this group. If, however, they pay more than these costs and the extra revenues from them are used to reduce the price to the non-favored group, part of the surplus is transferred to the latter group. However the surplus is distributed, it represents a net addition to satisfaction and is indeed the basic rationale of price discrimination.

If we have imperfect classification of customers, the conclusions above must be amended. In terms of Graph I, if DD represents the combined demand curves of both non-favored and favored consuming groups and a price OP is charged the former, a marginal price of OP′ charged the favored group will not cause them to demand the full amount up to point X′, because the demand for the product at point X′ represents in part demand for members of the non-favored group, who will not be permitted to buy at the lower price. At this point in their analysis Professors Winestone and Wichmann go astray. To sell X′ units, they point out, would require a price even lower than OP′, thus reducing even further the possibility of collecting some kind of a surplus from the favored customers to use to reduce the price to the non-favored customers.

This in itself would not be fatal, as we have pointed out above. But there is really no reason to reduce the price low enough to expand sales to X′. X′ represents the efficiency optimum only on the assumption of the original demand curve illustrated. If we are to vary our demand assumption, i.e., if we assume that at prices below OP only a part of the market will be permitted to buy, then we must shift our demand curve to the left, thus creating a new intersection of demand and marginal cost, and a new optimum output point. Any price lower than marginal cost induces inefficiency.

With their perverse treatment Professors Winestone and Wichmann have obscured some real difficulties arising out of the imperfect classification of customers. Space permits us to note only two:

(a) To the extent that members of the non-favored group are willing to buy more at marginal cost than at average cost but are denied this privilege of expanding their consumption at the lower price, efficiency is violated.

(b) Since the demand curve restricted to the non-favored group intersects the average cost curve at a lower output and hence, under decreasing costs, at a higher cost than the point at which the collective demand curve would intersect the average cost curve, the price to the non-favored group if set equal to average cost will be higher under discrimination than without discrimination. This violates our criteria of equity. Again, the solution would appear to lie in three or more steps in the pricing structure.

Neither of these difficulties would exist i perfect classification were possible, but this requires more knowledge of demand functions and a greater ability to separate classes of customers or uses than exist in practice. Classification by type of use or by units of consumption is probably better in this respect than the classification by customer

[2] The further requirement, that the demand curve cut the marginal cost curve from above, is obviously satisfied in the cases we are discussing.

groups to which Professors Winestone and Wichmann confine their discussion.

The case with decreasing marginal cost, where two-step pricing (average cost and marginal cost) would not provide sufficient revenues to cover total costs, raises the possibility of public subsidization, i.e., using tax revenues to finance that part of the costs not covered by revenues from consumers. What can be said about the effect of such a policy on total social satisfaction? Professors Winestone and Wichmann say, "It is questionable whether there is any net gain to the community since there is no way of measuring the loss to the taxpayers compared to the gains by the consumers." (p. 151)

The basic question here is whether we accept market valuations as adequate representations of true or social valuations. If we do, as Professors Winestone and Wichmann do in their basic discussion, we have a simple way to measure the respective loss and gain in satisfaction from subsidization. The loss to the taxpayers equals the amount of the tax paid and in this case equals that part of the cost which is subsidized. The gain to the consumers is measured by what they would be willing to pay for the subsidized output, less their actual payment. As in the usual case, the net gain to the community is the area between the demand curve and the long run marginal cost curve. If we accept market valuations, the efficiency of such subsidization is clear. Whether it is considered equitable to have this redistribution of income from taxpayers to consumers is quite a different question.

If, on the other hand, we reject market valuations as adequate measures of social costs and benefits, we can say nothing about the net gain or loss from subsidization. Nor can we, in the absence of knowledge of social values, evaluate the efficiency of the price or output of any product, firm, or industry, even the purest of competitive industries.[3]

Complete price discrimination, where every customer is charged the maximum amount he is willing to pay for every unit of the product, is the third pricing method discussed by Professors Winestone and Wichmann. In part their discussion is clear. This would create total revenues in excess of total costs, in the ordinary case. The regular demand curve becomes the new marginal revenue curve and the new average revenue curve now lies above the old demand curve, intersecting the average cost curve at point Z, in Graph I.

Professors Winestone and Wichmann attribute some special meaning to this intersection Z. They test it two ways. First, if the minimum price is set at this level (i.e., OP″), total revenues will exceed total costs and, unless the demand and cost curves have certain special properties which they specify, the average price will exceed the average price which would exist if there were no discrimination. This is clearly inequitable. On the other hand, as in their second test of point Z, discrimination permitted to such a degree that output and sales are extended to output Z would "force marginal social value substantially below marginal social cost." (p. 153)

With all this we can agree, but what is its relevance? Who has ever proposed that the intersection of average cost and this average revenue determine either the limiting price or the limiting output under complete discrimination? It is peculiar (and significant) that Professors Winestone and Wichmann do not bother to draw in a marginal cost curve when considering this case, for one cannot discuss an optimum position without it. Surely the proper limits of complete or incomplete discrimination, with respect to both output and minimum price, are determined by the intersection of the marginal cost curve and the demand curve (i.e., point C in Graph I). This is the efficiency optimum, whatever the pricing.

On equity grounds, however, this degree of complete discrimination is undesirable on two counts: total revenues will exceed total costs and many customers will be required to pay a price above average cost. Here the price discrimination is obviously overdone. The solution is simply to discriminate enough to cover total costs but no more, charging no one more than average cost and no one less than marginal cost, while maintaining the efficiency output. The case of complete discrimination is particularly interesting for it shows a monopolist will thereby maximize profits by producing the efficient output, but it is generally undesirable on equity grounds.

To summarize our results: with decreasing cost firms, average cost pricing satisfies our concepts of equity but not efficiency. Assuming perfect classification, a properly designed discriminatory structure can satisfy both criteria as follows:

[3] Unless we resort to that neat but impractical device, the compensation principle.

(a) If marginal cost is constant, two prices are sufficient, one at average cost and the other at marginal cost. (b) If marginal cost is rising, two prices will also suffice: the lower price equal to marginal cost, and the higher price at whatever level is necessary to make total revenues equal to total costs. Since the low price group is providing revenues in excess of their costs, the higher price will be less than average cost. (c) If marginal cost is falling, three or more prices are necessary (but not complete discrimination[4]): a high price equal to average cost; a low price equal to marginal cost; and one or more intermediate prices between average and marginal cost designed to provide revenues sufficient to fill the gap between total costs and the revenues provided by the other two groups without curtailing the consumption of this middle group below the level which would obtain if they were charged marginal cost.[5]

Price discrimination is not a universal pricing panacea. Whether the advantages of discrimination discussed above are outweighed by the difficulties of determining costs and demand, classifying customers or units of consumption, and devising a pricing structure which induces efficiency while satisfying concepts of equity, must be decided case by case. This note is designed, not to defend or attack price discrimination as a technique, but to help clarify its nature. This is surely a prerequisite to evaluation.

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[4] Except in the most extreme case, where complete discrimination is necessary to cover total costs. This would mean, however, that the demand curve would lie below the average cost curve for its entire length, and that there would be no production unless discrimination is complete. In this case total benefits would never exceed total costs, and only at one output (where average cost equals average revenue under complete discrimination, which is the point at which the demand curve would cut the marginal cost curve) would total benefits equal total costs. Under no other circumstances would complete discrimination be necessary to cover total costs.

[5] In each of these three cases, intermediate prices may be added, if desired, to provide revenues in excess of marginal cost, which will permit a reduction of the price to the non-favored group. This is a logical step if it is considered equitable to distribute the gains from discrimination among all consuming groups. The danger here lies in the possibility of setting prices which will reduce consumption, thus defeating the whole purpose of the discriminatory price structure.

Estimating Household Size in Urban Redevelopment†

ONE of the more difficult problems encountered in slum clearance and urban redevelopment is the accurate estimation of household sizes to be planned for in redeveloped residential areas. Vacancies, inefficient land use, and financial losses will inevitably result if the kind of housing to be built in such areas is designed for households either larger or smaller than the actual market for future occupancy. Households found in project areas prior to redevelopment are unlikely to resemble those which will occupy the site after redevelopment. Relatively little research has been published as a guide for solving this difficulty. As a consequence, planning new residential structures for a project area poses awkward problems.

Existing households in redevelopment areas present few clues to the size of apartment most likely to satisfy the needs of future residents of the area. Present occupants tend to be low-income families and unrelated individuals who often find difficulty in paying even present rentals. They are frequently doubled-up or otherwise overcrowded. After redevelopment of the area, in contrast, residents will presumably be higher-income persons capable of meeting the increased rent levels to be expected. Doubling-up and overcrowding will be much less common. Even where public housing is planned to replace existing slum areas, changes in the number of rooms per unit will obviously be indicated.

How then can an accurate, objective estimate be made of the size of household to be expected in a given redevelopment project? Study of the various cross-tabulations published as part of the 1950 United States Census of Housing can be helpful, but such an analysis must necessarily omit consideration of many important variables not ordinarily

† The author, currently employed as Associate Research Technician for Population Studies for the State of California, Department of Finance, completed this study while working as Redevelopment Research Analyst for the Honolulu Redevelopment Agency.

included in census reports.[1] The refined techniques proposed by Dutch authorities are largely inapplicable to American cities.[2] Special field surveys might be undertaken to locate and interview potential residents of project areas, but only at considerable expense.

A promising alternative to the methods suggested above is provided by the use of multiple regression techniques. This approach has been followed frequently in other fields but remains largely untried in housing market analysis. Application of this method may be illustrated with reference to a recent study by the Honolulu Redevelopment Agency.[3] The Agency's research, although concerned specifically with its "Queen Emma Project" adjacent to the Honolulu central business district, presents problems similar to those likely to occur in any medium-sized American city.

The Honolulu study consisted basically of a multiple regression analysis of census tract statistics from the 1950 United States Census.[4] In this analysis, four measures of household size were used as dependent variables, and seven presumably related series were taken as the independent variables. The regression equations based on these data described the relationship between each associated factor and household size in Honolulu, under 1950 conditions. Assumed or planned characteristics for the Queen Emma Project were substituted in the equations to estimate future household size. By varying the magnitude of each item, it was possible to see the extent to which household size would be affected. This method permitted the development of estimates for a totally hypothetical situation, unlike any found in Honolulu today, from data for a known universe as of 1950. It likewise circumvented the limitations found in other approaches, not, however, without introducing difficulties of its own. In conjunction with other data, it provided a highly flexible, statistically defensible technique for anticipating trends in household size in Honolulu project areas.

The four dependent variables were chosen to measure various aspects of household size. Variable "A" was average household size; variable "B", dwelling units with one or two occupants as a percent of all occupied units; variable "C", dwelling units with three or four occupants as a percent of all occupied units; and variable "D", dwelling units with five or more occupants as a percent of all occupied units.[5]

There were seven independent variables. Variable "a" was owner-occupied dwelling units as a percent of all occupied units; variable "b", dwelling units in one-unit structures as a percent of all dwelling units; variable "c", dwelling units built in 1940 or later as a percent of all dwelling units reporting year built; variable "d", rental units with contract monthly rent of $60 or more as a percent of all rental units reporting rent; variable "e", dwelling units without private bath or dilapidated as a percent of all units reporting condition and plumbing; variable "f", net area (acres in residential, semi-residential, or potentially residential use) per dwelling unit; and variable "g", average peak-hour driving time, in minutes, to the heart of the central business district.[6]

The independent variables were selected to satisfy three major criteria: (1) a high degree of association, on *a priori* grounds, with average household size; (2) availability of data on a census tract basis for 1950; and (3) ease of anticipating project area values for the post-redevelopment period. Variable "d", the percentage of rental units renting for $60 or more per month, is an example of general conformity to these principles: (1) everyday observation indicated a close correlation between rent levels and household size; (2) data by tract for 1950 were available from the 1950 U. S. Census; and (3) economic analysis clearly indicated the minimum level of rents to be expected after redevelopment if apartment housing planned for the area was to be economically feasible.

Although selection of variables was conditioned chiefly by forecasting requirements, the choice proved eminently successful on theoretical grounds as well. Between the seven independent variables and average

[1] U. S. Bureau of the Census, *U. S. Census of Housing, 1950*, Vol. II, *Nonfarm Housing Characteristics*, tables 1, 2, 4, 5, 7, 8 and 9 for each Standard Metropolitan Area and city over 100,000.

[2] Central Directorate of Reconstruction and Housing in the Netherlands, "A New Statistical Method to Estimate the Need for Bedrooms," *News Sheet of the International Federation for Housing and Town Planning* (The Hague), August 1955, pp. 19-22.

[3] Honolulu Redevelopment Agency, "Household Size in the Consolidated Project Area After Redevelopment," *Redevelopment and Housing Research*, No. 4, April 1956, pp. 15-31.

[4] U. S. Bureau of the Census, *U. S. Census of Population: 1950*, Vol. III, *Census Tract Statistics*, Chapter 62.

[5] *Ibid.*, tables 1 and 3.

[6] Computed from *ibid.*, table 3, except variables "f" and "g" (available locally).

household size, for example, the coefficient of multiple correlation was 0.9103, indicating that the analysis accounted for about eighty-three percent of the statistical variation reported. Multiple correlations were 0.8812 with the percent of households of less than three persons, 0.7125 with the percent having three or four persons, and 0.9123 with the percent with five or more persons. Pertinent zero-order and partial correlation coefficients have been published elsewhere.[7]

The regression equations based on these data provided a basis for estimating future household size. The equation for persons per household, for example, was

$$Y = 2.7960 - 0.0101X_a + 0.0338X_b + 0.0105X_c - 0.0165X_d + 0.0087X_e + 0.0137X_f - 0.0256X_g$$

when Y was average household size and the variables to the right represented the seven items correlated with household size. For variables "B", "C", and "D", similar regression equations were developed.[8]

Assumed values for the independent variables were then substituted in the equations. These assumed values were based on present plans or reasonable expectations for the Queen Emma Project after redevelopment. With respect to rent, for example, it was assumed that fully ninety percent of all rental units in the project area would rent for $60 or more (at 1950 levels, corresponding to 1956 rents of $70 or more) when completed. It was further hypothecated that this ratio might range as low as eighty percent or as high as 100 percent, thus providing a basis for alternative "high" and "low" computations. It was likewise assumed that driving time to the central business district, estimated to be six minutes in 1950, would most probably drop to five minutes with construction of a proposed highway through the area, with a possible range of three to six minutes. Other values for the post-redevelopment period were assigned in a similar fashion.[9] Substitution of these values in the regression equations produced estimates of anticipated household size.[10]

Considerable caution was necessary in interpreting the findings. Computed values for 1950 differed somewhat from the corresponding observed values. Both "most probable" and "low" post-development estimates for percent of households with five or more persons resulted in negative values, so that adjacent categories had to be grouped to avoid impossible results. Finally, it was recognized that the equations were based on averages and rates for sixty-one census tracts of frequently heterogeneous composition while the post-redevelopment estimates related to a single hypothetical area characterized by considerable homogeneity.

Even after allowance for the foregoing methodological deficiencies, however, a striking reduction in household size in the Queen Emma Project appeared likely after redevelopment. Persons per household, under "most probable" conditions, will be about 2.2 according to the regression equation, compared with a 1950 level of 3.5. Assuming simultaneous attainment of the "high" values for all seven independent variables—a most improbable development—the ratio of persons to households would still be less than 2.5. At the other extreme, the "low" figure is only 1.9. Between fifty and sixty percent of all occupied units are likely to have only one or two members, and no more than four percent will have as many as five members.

The findings were carefully checked against information available from other sources. The estimates based on multiple regression analysis proved somewhat lower than those derived from alternative approaches, but lay well within the limits of sampling variation and reasonableness.[11]

Housing market analysts in other American communities may find the approach described in the foregoing paragraphs well worth using in their own areas. Most of the statistics needed for a multiple regression analysis appear in the series of sixty-two census tract bulletins published as part of the 1950 Census program. Further expansion of census tract coverage is promised for 1960. Opportunities for testing this technique and others like it will thus increase greatly in the coming years.

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[7] Honolulu Redevelopment Agency, *op. cit.*, pp. 27-28.
[8] *Ibid.*, p. 29.
[9] *Ibid.*, p. 30.
[10] *Ibid.*, p. 31.
[11] *Ibid.*, pp 16-18.

Book Reviews

Housing in Great Britain. By Herbert Ashworth. London, England: Thomas Skinner & Company, Ltd., 1957, pp. 157, 7s, 6.

This book provides a concise, lucid, and interesting account in 157 pages of housing policy and standards. Probably in no other such condensed form will the American reader find a discussion with historical perspective covering housing requirements, rate of construction, finance, standards for construction and design, and town and country planning.

Though the author as General Manager and Secretary of a large nation-wide building society has misgivings about government policies that hamper business, he retains the objectivity to be expected from his training as an economist. For example, on subsidies for families displaced by slum clearance, the author says: "The Housing Acts make provision, therefore, for the closing or demolition of unfit houses either singly or in groups, the latter being designated 'clearance areas.' Action is taken where houses are adjudged to be unfit for human habitation and incapable of being made so at reasonable expense, regardless of whether there are tenants in occupation or willing to occupy. Clearly, local authorities' slum clearance campaigns accelerate the process of replacement. Moreover the replacement process is in such circumstances often direct; the local authority being empowered to erect dwellings for the rehousing of the occupants of the condemned houses. Subsidies are provided to enable the new houses to be let to the persons concerned at rents they can afford. Without subsidies, the classes concerned would be unable to pay the rents required to cover capital charges and outgoings."

Concerning the progressive abolition of rent control as provided by the Rent Bill of 1956, he says ". . . . The gradual abolition of rent-control will undoubtedly have the effect of rescuing still useful properties from further deterioration."

The role of local authorities, private builders, housing associations or public utility societies, building crafts, commercial banks, building societies, insurance companies, savings banks, Public Works Loan Board, the government's Building Research Station, National House-Builders Registration Council, and Ministry of Town and Country Planning are clearly revealed.

To the non-British reader the specific roles of the Ministry of Works, Ministry of Health, Ministry of Housing and Secretary of State for Scotland are not so clearly indicated.

Some terminology is not fully understood by the American reader such as "maisonettes" or "flatted house" but usually the wording is familiar. Helpful is the distinction between garden cities and new towns on one hand and suburbs on the other. Short chapters and frequent topical headings partially compensate for lack of an index.

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Man's Role in Changing the Face of the Earth. Edited by William L. Thomas, Jr., with the collaboration of Carl O. Sauer, Marston Bates and Lewis Mumford. Chicago: University of Chicago Press, 1956, pp. 193—xxxiii. $12.50.

This is an encyclopedic book of the interrelation of man and his environment. It is the product of a symposium sponsored by the Wenner-Gren Foundation for Anthropological Research. One of the stated purposes of the foundation in organizing the symposium was to make ideas from other fields available for the solution of anthropological problems. Seventy participants were brought together. "About 40 percent were in the field of earth sciences, 28 percent in the biological sciences, 12 percent in the social sciences and humani-

ties, and 20 percent in applied fields (administration, city planning, etc.)." (p. xxvi)

The relation of man to climate, soils, plants, animals, waters, minerals and wastes is discussed in fifty-three papers. These papers are divided in three main parts: Retrospect, Process and Prospect. The first deals with a variety of historic civilizations established by man, their response to their environment and their lasting impact on that environment. The second part is a review of the accumulated scientific knowledge of the consequences of man's actions on specific components of the environment. The third part deals with the limits that the earth is likely to impose on man's activities. In addition to papers each of the three parts of the book includes an account of the views presented in symposium discussions.

The recurrent theme is ecological. The emphasis varies from the conception of man as limited by the potentialities of the ecological balance to man as an ecological dominant creating a new environment with greater or smaller potentialities than the original.

To one not familiar with ecology (and this includes the reviewer) the impact of man on his natural environment is surprisingly broad and varied. Some scientists now believe that the extensive grasslands of Argentina, Russia and North America are due to fires lit by prehistoric men (pp. 126-129). Man is unintentionally responsible for the creation and spread of weeds and wild plants as well as for breeding of cultivated plants (pp. 763-777). A long list of the consequences of man's activity can be accumulated from this book.

The impact of man is also considered in relation to a technological environment created by science and the industrial revolution. Minerals can be considered industrial "foods." The relation of their supply to population growth can be analyzed in a manner parallel to the Malthusian analysis of food supply, (pp. 1114-1116). The shortage of these industrial "foods" is probably more imminent than shortage of food.

Characteristically man's activity in his environment produces unplanned and even unseen consequences besides those that are desired. In time the environment changes sufficiently so that adaptation and new use of the environment are necessary. (An example might be a change in land cover from woodland to grassland to sage.) The development of new technology produces new interactions with nature, with a new gamut of consequences, some of which are desired but others again are unplanned and unappreciated. The industrial revolution and the development of modern science have greatly speeded up the rate at which new interactions are introduced. Despite scientific knowledge, unplanned and cumulative effect on the environment continues to accompany man's actions.

Economists can use this book as a source of background knowledge for a number of areas in which they have to work. Teachers, research workers and administrators in land and water economics, peasant agriculture, conservation, minerals, transportation, recreation, city and regional planning, resource development and development of underdeveloped countries will find parts of this book interesting and highly useful as introduction to specific fields of knowledge. This usefulness is enhanced by the bibliographies made available with each chapter.

The contribution of economists to the symposium was restricted to comments made during discussions by Frank Knight and Kenneth Boulding. Boulding even contributed a poem, *A Conservationist's Lament* and *The Technologist's Reply*, which reproduced concisely the spirit of the meeting (p. 1087).

A very brief but suggestive discussion of differences between a "biological-ecological" point of view and a "socioeconomic" viewpoint was stimulated by remarks made by Boulding (pp. 447-8, see also pp. 432-3). The natural scientists use a number of concepts of natural limits imposed on the activity of man. The simplest of these consists in pointing out the impending exhaustion of fossil fuels (coal, oil and gas). A much more complex model is that of a biotic pyramid of microbes, plants, animals and man limited by the fertility of the soil. Scientists can also attempt to estimate the maximum amounts of energy obtainable from sun's rays.

In terms of economic theory these models state that some resources are in fixed or diminishing supply. In turn this would imply lower reproductivities of labor and reproducible forms of capital. The last conclusion is precisely the one that many natural scientists do draw.

However, this conclusion is based on strict differentiation of the economic significance of natural resources, labor and capital. The best theoretical objection to this position has come from Frank Knight who pointed out

that it is possible to invest and thus form capital in the form of any of the three factors of production.[1] All resources regardless of their physical form can be regarded from the point of view of economics as capital. Existing supplies of fossil fuels should then be considered to be the fruits of investment in prospecting, and in developing the technology of processing and using these fuels rather than simply as gifts of nature. This position implies that future investments in production of food or energy should not be made impossible by the exhaustion of any specific physical or biological resource now existing or that food or energy costs need necessarily rise. The other alternative is that the limits on man's activity that the natural scientists are pointing out are absolute limits. The theoretical status of these limitations should be very interesting to economists and it should lead to a reclassification of the different factors of production distinguished in economic theory.

Of particular interest to all social scientists are the discussions of the adjustment of various cultures to their environment, the interrelation of cultural and environmental change, and cultural differences in attitudes toward the environment. These topics are presented primarily in the papers constituting the first part of the book (Retrospect), in a paper by F. S. C. Northrop on "Man's Relation to the Earth in Its Bearing on His Aesthetic, Ethical and Legal Values" (pp. 1052-1065) and in the symposium discussions.

The interpretations of the past and of cultural differences now existing are scholarly and enlightening. On the other hand, those symposium discussions which are largely concerned with man's lack of regard for his mismanagement of the environment and of man's values as obstacles to better adjustment have little to contribute. The generalities used in discussion of values are rather striking in contrast to the precise and detailed manner with which biological and physical phenomena are described. Missing from the discussion is the awareness that political scientists have of the processes that can lead to the assumption of public responsibility for resource development and public control over private resource use. Unfortunately no political scientists have been included in the proceedings of this symposium.

This is a valuable book. It serves as an introduction and a brief review of accumulated knowledge in many fields of study relevant for economists. It raises important problems. It is interesting and readable.

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[1] See his "Diminishing Returns from Investment," *Journal of Political Economy*, March 1944, pp. 26-47.

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